This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

BULLETIN NO. 12

OF THE

ILLINOIS STATE MUSEUM

OF

NATURAL HISTORY.

NEW SPECIES OF CRINOIDS CEPHALOPODS AND OTHER PALÆOZOIC FOSSILS.

By S. A. MILLER and Wm. F. E. GURLEY.

Springfield, Illinois,
January 25, 1897.

SPRINGFIELD, ILL.:
Phillips Bros., State Printers.
1897.

AM
101
.I354
183180
no. 12
1897

ILLINOIS STATE MUSEUM
OF
NATURAL HISTORY.

Springfield, Illinois.

BOARD OF TRUSTEES.

John R. Tanner, *Governor.*
James A. Rose, *Secretary of State,*
S. M. Inglis, *Superintendent Public Instruction.*

Miss Fannie Fisher,
Secretary.
William F. E. Gurley,
State Geologist and Curator.

NEW SPECIES OF CRINOIDS, CEPHALOPODS AND OTHER PALÆOZOIC FOSSILS.

BY S. A. MILLER AND WM. F. E. GURLEY.

SUBKINGDOM ECHINODERMATA.

CLASS CRINOIDEA.

ORDER PALÆOCRINOIDEA.

FAMILY ACTINOCRINIDÆ.

AGARICOCRINUS IOWENSIS, n. sp.

Plate 1, fig. 1, basal view; fig. 2, summit view; fig. 3, azygous view of the same specimen.

Species large, subpentagonal in outline, by reason of the extension of the radial areas. Calyx very deeply concave, and vault correspondingly convex, leaving a thin visceral cavity. Plates thick, convex, and giving to the whole form a very rugged aspect. Of this species we have three specimens, two of them are substantially alike, though one has a more convex vault which is somewhat more evenly rounded.

Basals form a flat hexagonal disc somewhat larger than the diameter of the column. First primary radials about as long as wide, and gently curve from the basal disc so as to form a concave bottom for the cavity of the calyx; three hexagonal, two heptagonal. Second primary radials a little wider than long, quadrangular. Third primary radials very little larger than the second and wholly within the concavity of the calyx, three hexagonal, two pentagonal, axillary, and support on the superior sloping sides the secondary radials. First secondary radials large, tumid or highly convex, the inferior part is within the cavity of the calyx and the superior

CATALOG
SEP 22 '34

part curves over horizontally, in the direction of the arms. In the ray on the right of the azygous area, in the specimen illustrated, the first tertiary radials are somewhat trapezoidal in outline, and do not cover the superior faces of the first primary radials, and the second tertiary radials rest on both the secondary and first tertiary radials; they are axillary and bear upon each upper sloping side a free arm, which gives to this ray four arms. In the ray on the left of the azygous area the second secondary radial, on the proximal side, bears a single arm, there is an intercalated large plate resting in the angle formed by the two first primary radials, which is axillary and bears upon each superior side a tertiary radial that supports a single arm, which gives to this ray three arms. Each of the lateral rays is constructed in the same way, and each one bears three arms. In the ray opposite the azygous area each second secondary radial bears a single arm, which gives to this ray two arms. There are, therefore, fifteen arms in this species, and fifteen ambulacral openings to the vault, which are very conspicuous in a summit view. The secondary and tertiary radials are tumid and pyramidal plates. One of the other specimens has the four-armed ray on the left of the azygous area, and the three-armed ray on the right. We have elsewhere shown that, in our opinion, this variation should not be regarded as of specific importance. The arms are composed of a double series of interlocking plates and each one is in the form of a sharp angular ridge on the lower side.

The first regular interradials rest between the superior lateral sides of the first primary radials and extend as high as the third primary radials. In the area adjoining the four-armed ray, it is followed by two plates that separate the secondary radials and first arm plates and curve over the margin of the calyx and unite with three plates belonging to the vault. In the area next to the left of the azygous area there are also three plates, but one of them is intercalated and rests on the top of the first secondary radial, and is cut off from uniting with the plates of the vault. In each of the other two areas there are only two plates, the second ones of which curve over the margin of the calyx and unite with the plates of the vault. Each of these plates in the second ranges are longitudinally convex or bear an elongated node. There are four plates in the azygous area. The first one is in line with the first primary radials and of about the same size. It is followed by three large and elongated plates in the second range that curve up out of the calicular cavity and over the margin of the calyx and unite with the plates of the vault.

The vault is highly convex and more or less concave in the interradial regions. There is a large tumid plate at the apex of the vault which is surrounded by eight plates, the two smaller ones of which unite with the minute plates that surround the azygous orifice. There is a large tumid plate over the junction of the ambulacral canals; the other plates of the vault are much smaller, but they are very irregular in size; the smallest ones are in the regular interradial and azygous areas. The azygous area is wide and covered by numerous plates. The orifice is at the superior part of a bulbous swelling and surrounded by small plates.

This is the first fifteen-armed species ever described and may be distinguished by that character alone. It is, however, to be distinguished by its general form, peculiar arrangement of the secondary radials, and by the regular interradial and azygous plates.

Found in the Keokuk group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley.

AGARICOCRINUS KEOKUKENSIS, n. sp.

Plate 1, Fig. 4, basal view; Fig. 5, summit view; Fig. 6, azygous view of same specimen.

Species large, subpentagonal, in outline, by reason of the extension of the radial areas, calyx very deeply concave and vault very highly convex leaving a thin visceral cavity, and, in these respects, very much resembling *A. iowensis* above described. Plates thick, convex, and giving to the whole form a rough aspect.

Basals form a slightly concave hexagonal disc that is substantially covered with the end of the column. First primary radials about as long as wide, and gently curve from the basal disc so as to form a concave bottom for the cavity of the calyx, three hexagonal, two heptagonal. Second primary radials nearly as long as wide, quadrangular. Third primary radials somewhat wider but not any larger than the second and wholly within the concavity of the calyx, pentagonal, axillary, and support on the upper sloping sides the secondary radials. First secondary radials large, tumid and having the inferior end within the cavity of the calyx, and the superior part curving over, horizontally, in the direction of the arms. In the ray on the left of the azygous area the first secondary radials are axillary and on each proximal side support two tertiary radials and on one distal side a single large tertiary radial and on the other, which adjoins the azygous area, three tertiary radials, which arrangement gives to this ray four arms. One of the lateral rays is constructed in a somewhat similar manner, though, on one of the proximal sides of the first secondary radials, there are two tertiary radials, and, on the other, there are three, and, on each of the distal sides, there are two tertiary radials, which gives to this ray four arms. In the ray on the right of the azygous area there is a pentagonal plate inserted in the angle formed by the first secondary radials which supports upon each of three sides a single tertiary plate; those resting on the lateral sides are also supported on the first secondary radials, which gives to this ray three arms. In the other lateral ray there is an hexagonal plate inserted in the angle formed by the first secondary radials, which bears upon one upper side a single plate that supports a single arm and upon each of two sides a plate that supports a single arm, and upon the other a plate that supports upon each of two sides a plate, that together support a single arm, which gives to this ray three arms. In the ray opposite the azygous area the first secondary radial supports on one side a single secondary radial that supports an arm and the other secondary radial supports two plates that support a single arm, which gives to this ray two arms. There are, therefore, sixteen arms in this species, and sixteen ambulacral openings to the vault, which are very conspicuous in a summit view. The arms are composed of a double series of interlocking plates and each one is in the form of a sharp angular ridge on the lower side.

In each regular interradial area there are three plates, one following the other. The first one rests between the superior lateral sides of the first primary radials and extends as high as the third primary radials. The second one extends about as high as the first secondary radials and the third one curves over the margin of the calyx and unites with the plates of the vault. In the azygous area there are six plates. The first one is in line with the first primary radials and about the same size. It is followed by three plates, the middle one of which curves up out of the calicular cavity and over the margin of the calyx and unites with the plates of the vault. Each lateral one extends about as high as the first secondary radials and is followed by another elongated plate that curves over the margin of the calyx and unites with the plates of the vault.

The vault is exceedingly convex and very slightly depressed in the interradial areas. There is a large tumid plate at the apex of the vault, which is surrounded by seven large tumid plates. There are three large tumid plates over the junction of the ambulacral canals in each of four of the radial series, and one over the junction of the ambulacral canals, in the ray opposite the azygous area. The other plates of the vault are much smaller, but very irregular in size, the smallest ones are in the regular interradial and azygous areas. The azygous area, is wide and covered by numerous polygonal plates. The azygous orifice is at the superior part of a bulbous swelling and surrounded by small plates.

This is the first sixteen-armed species ever described except the *Actinocrinus* (?) *helice* of Hall to which it bears very little, if any, resemblance. It would seem to be as nearly related to *A. iowensis*, above described, as to any other species, but it is widely different from that species, in the azygous and interradial areas, in the secondary and tertiary radials, and in the plates of the vault, beside having sixteen arms while that species has only fifteen. It is a very strongly marked species.

Found in the Keokuk Group, at Keokuk, Iowa, and now in the collection of Wm. F. E. Gurley.

REMARKS ON AGARICOCRINUS.

Agaricocrinus is a well marked genus that does not graduate into any other nor toward any other through any of the species belonging to it. It is only known from the lower half of the Subcarboniferous System. It first makes its appearance in the Chouteau limestone. Here we find *A. blairi*, which has a subquadrate flattened body and bears only nine arms. The ray opposite the azygous area bears a single arm, and each of the other rays bears two. It is the only nine-armed species that has been described, and has very little resemblance in either form or structure to any genus or species that preceded it. There have been described, also, from the Chouteau limestone, three ten-armed species, viz.: *A. germanus*, which is a small species, having a flattened body and a tumid plate above each ambulacral orifice; the vault is covered by fewer plates than any other known species; *A. chouteauensis*, which has an abrupt basal depression, subconical vault, and unequal radial series; and *A. sampsoni*, which bears very large arms, in proportion to the size of the flattened calyx. These species are widely separated from each other and readily distinguished by any one having any knowledge of the structure of crinoids, but they are not linked by any series of gradation with any known genus or species belonging to an earlier age.

Prof. James Hall described twelve ten-armed species from the Burlington Group, viz.: *A. bellitrema, A. convexus, A. corrugatus, A. brevis, A. excavatus, A. inflatus, A. geometricus, A. ornotrema, A. pentagonus, A. planoconvexus, A. pyramidatus* and *A. stellatus.* Of these only eight, viz.: *A. excavatus, A. brevis, A. pyramidatus, A. stellatus, A. convexus, A. ornotrema, A. pentagonus,* and *A. geometricus* have been, in any manner, illustrated. We have had occasion to examine the definitions and illustrations as well as specimens belonging to these eight species and have found no synonymy among them. *A. bellitrema* has been called a synonym for *A. ornotrema,* and *A. corrugatus* has been called a synonym for *A. pyramidatus*; but *A. planoconvexus* and *A. inflatus,* from their definitions, seem to be good species. It would be very gratifying to have some one illustrate these two species, who has some knowledge of fossils, in order that they might take their rank with other described and illustrated forms. We described *A. illinoisensis,* which has a depressed body with a peculiar pentagonal outline and ten arms, from the Burlington Group. These are all the ten-armed species that have been described from this Group.

There have been described, from the Burlington Group, five twelve-armed species, viz.: *A. bullatus, A. fiscellus, A. nodosus, A. hodgsoni* and *A. adamsensis,* all of which have been illustrated, except *A. fiscellus.* It was described by Prof. Hall as an *Actinocrinus* and he said: "It is not of the type of *Agaricocrinus,* Troost, or *Amphoracrinus.*" His definition, however, would lead us to suppose he had before him an *Agaricocrinus* and a distinct species. *A. bullatus,* Hall, and *A. nodosus,* Meek and Worthen, are distinct and well characterized species very far removed from *A. americanus,* with which they have been erroneously classed by some, as synonyms.

The above are all the species which have been defined from the Burlington Group, and, it will be noticed, that they possess either ten or twelve arms. Prof. Meek mentioned the fact that he had seen an eleven-armed specimen, but he did not describe it.

There have been described from the Keokuk Group, three ten-armed species, viz.: *A. arcula, A. whitfieldi* and *A. wortheni.* They have been quite fully illustrated and are very distinct species.

There have been described, from the Keokuk Group, eight twelve-armed species, all of which have been properly illustrated. They are as follows: *A. crassus*, *A. elegans*, *A. eris*, *A. indianensis*, *A. splendens*, *A. springeri*, *A. tuberosus* and *A. tugurium*. These species are widely different from each other and clearly distinct. *A. eris* is from Richfield, Ohio, and, at the time of its original definition, was referred to the Waverly Group; but the rocks are decidedly above the Waverly Group, and are now known to belong to the Keokuk.

A. tuberosus, Hall, is properly the type of the genus. Prof. Hall published Troost's Mss. definition of the genus (Geo. Sur. Iowa, 560), and said it was founded upon *A. tuberosus*, proposed by Troost, which he said had been later described by Roemer, under the name of *Amphoracrinus americanus*. Prof. Hall then proceeded to define *A. tuberosus* (Geo. Sur. Iowa, 617), and very fully described a twelve-armed species, which is very common about Keokuk, Iowa, and of which we have examined more than one hundred good specimens. The species described by Roemer, under the name of *Amphoracrinus americanus* has very little resemblance to it, and is, as we understand his illustration, a fourteen-armed species, and we have specimens of it collected at the typical locality in Tennessee, which bear fourteen arms. The Mss. name, *A. tuberosus*, Troost, has no validity, because he did not define the species and because no one else has published what he said about it. Prof. Hall used the specific name *tuberosus* supposing that he was applying it to the same form to which Troost had applied it and to which Dr. Roemer had given the name *americanus*; but he was applying it to quite a marked and different species which he carefully described, and which must bear his name, because a catalogue name does not preoccupy a word or give it any force as a specific name. The name is, therefore, *A. tuberosus*, Hall, and not *A. tuberosus*, Troost. Prof. Hall followed the definition of the genus, with the description of the species *A. bullatus*, and published the definition of *A. tuberosus* farther on in the book, but that does not affect the question of the type of the genus, for he very clearly set forth *A. tuberosus* as the type.

The mistake of calling *A. tuberosus* a synonym for *A. americanus* has, probably, been carried into the literature of the subject, because so few copies of Bronn's Lethea Geognostica, in which Roemer published his *A. americanus*, ever reached America. We have never been able to obtain a copy of the work, but Dr. Suess, of Philadelphia, has furnished us with a copy of the figures 15*a* and 15*b* and a translation of the definition which is as follows:

"Amphoracrinus americanus, n. sp.

"The whole surface is a somewhat depressed expansion of the lower half of the calyx, which gives to this species a widely different aspect from the type of the genus. It is also considerably smaller there than *A. gilbertsoni.* An examination of the figures will show the sculpturing of the plates which is characteristic of every species."

This definition would not be sufficient to establish a species, but the figure, 15*a*, gives an azygous side view of an *Agaricocrinus* and shows four arm openings, upon each side of the azygous area, and the figure 15*b* shows a basal view of the calyx, and that the ray on each side of the azygous area possesses four arms and each of the other three rays possesses two arms, which gives to the species fourteen arms. After receiving these drawings we were able to identify four specimens, from Roemer's type locality, at White Springs, Tennessee, with *A. americanus*. We have examined a great many specimens of *Agaricocrinus* from the Keokuk Group of Kentucky and Tennessee, but have not found a single specimen of *A. tuberosus*, Hall, among them.

Our specimens of *A. tuberosus* show a great variation in size, in the concavity of the calyx, and height of the vault. The proportional length of the secondary radials differs, in different specimens, and in some specimens the rays, on each side of the azygous area, are much more prolonged than in others, this is especially the case in large specimens, with a depressed convex vault; but the fundamental structure and arm formula remain so constant, that there is no difficulty in referring them to the same species.

There has been only one thirteen-armed species, *A. gorbyi*, described from the Keokuk Group.

There have been three fourteen-armed species described from the Keokuk Group, viz.: *A. americanus*, *A. dissimilis* and *A. profundus*. They are all very pronounced and distinct species.

There has only been one fifteen-armed species described from the Keokuk Group, viz.: *A. iowensis*, above defined.

A. keokukensis, as above described, has sixteen arms.

Agaricocrinus (?) *helice* described as *Actinocrinus helice* from the Waverly Group, at Richfield, Ohio, which, as above remarked, is from rocks above the Waverly Group and belonging to the Keokuk, has, as stated, in Ohio Pal., vol. 2, p. 163, an arm formula of 4+3+2+3+4=16 arms, or 4+3+2+4+4=17 arms. We are inclined to think that two species are described here under one name; but specimens from that locality are very poor, and those which we have, possess only sixteen arms, and we cannot throw any additional light upon the subject. The reference of the species, however, to *Agaricocrinus* is very doubtful.

Agaricocrinus nodulosus from the Keokuk Group has 17 arms. The arm formula is 4+4+2+4+3. And *A. macadamsi* has 18 arms. The arm formula is 4+4+4+3+3. This species is one of the largest, has the most numerous arms and belongs to the last of the race.

We have thus taken, briefly in review, all the species of *Agaricocrinus* that have been described. They belong to the Chouteau, Burlington and Keokuk Groups. Names have been given to forty two species. All of these have been illustrated except five, three of which are believed to be good and valid species and the other two may be classed as doubtful, because they were named thirty six years ago and have never been illustrated, and some authors have said they are synonyms. All we can say is that we have not identified them in our collections. It is very easy for some to say, that one species is a synonym for another, but the student will find that good authors rarely make a synonym, and, if one occurs, it is under such circumstances that ordinary prudence will not guard against it. We have seen ten-armed species described by Hall, from the Burlington Group, twelved-armed species described by Hall from the Bnrlington Group, twelve-armed species described by Meek & Worthen from the Burlington Group, and twelve-armed species described by Hall from the Keokuk Group, all of which have been finely illustrated, and occur, in Iowa and Illinois, classed as synonyms for *Agaricocrinus americanus,* which has never been described, but which is a fourteen-armed species, as shown by the illustrations, and has never been known to occur, except in the Keokuk Group of Tennessee. Such erroneous classifications are without any discrimination, and usually without examination, but there is no way of preventing the pretensions.

We would again call attention to the distribution of the species in the different Groups of rocks. The species from the Chouteau limestone are small and bear either nine or ten arms. Those from the Burlington Group are larger than those from the Chouteau, but are not as large, generally, as those from the Keokuk. The Burlington forms described possess either ten or twelve arms, but Prof. Meek mentioned a specimen with eleven arms which he thought was abnormal. Those from the Keokuk Group possess ten, twelve, thirteen, fourteen, fifteen, sixteen, seventeen or eighteen arms. The Chouteau forms have a depressed body, the calyx is almost flat and only slightly concave about the column, and the vaults are depressed convex or only moderately elevated. Some of the Burlington forms are constructed upon a somewhat similar plan, but others have a deeply concave calyx and highly convex vault. None of the Keokuk forms are like the Chouteau species, but some of them resemble some of the Burlington species, though generally they are more robust and have deeper calices and higher vaults.

The genus *Agaricocrinus* has not been found, so far as we are advised, in the Waverly Group of Ohio, in the Marshall Group of Michigan, in the Kinderhook Group of Indiana, Illinois or Iowa, notwithstanding there are numerous very fossiliferous localities, many of which, like Rockford, Indiana, and Burlington and Le Grand, Iowa, are famous almost all over the world. It occurs in rocks of that age only in the Chouteau limestone of Missouri. The genus has been recognized, however, at almost every locality where the Burlington or Keokuk Group has been determined, in Iowa, Missouri, Illinois, Indiana, Ohio, Kentucky and Tennessee. The abrupt appearance of the genus *Agaricocrinus* in the Chouteau limestone, in a single locality in Missouri, and its confinement to that geographical locality throughout that geological age, and its distribution over seven states during the two succeeding geological ages, that are represented by the Burlington and Keokuk Groups, and its abrupt disappearance before the close of the Keokuk age, is wholly a mystery to us, and can be in no manner accounted for by our knowledge of the theory of evolution. Sir Charles Lyell, in speaking of the distribution of living genera, said:

"Dr. Bachman pointed out to me ten genera of birds and ten of quadrupeds, all peculiar to North America, but each represented on the opposite side of the Rocky Mountains by distinct species. The theory of specific centers, or the doctrine that the original stock of each species of bird and quadruped originated in one spot only, may explain in a satisfactory manner one part of this phenomenon, for we may assume that a lofty chain of mountains opposed a powerful barrier to migration, and that the mountains were more ancient than the introduction of these particular quadrupeds and birds into the planet. But the limitation of peculiar generic types to certain geographical areas, now observed in so many parts of the globe, points to some other and higher law governing the creation of the species itself, which, in the present state of science, is inscrutable to us, and may, perhaps, remain a mystery forever. The adaptation of peculiar forms, instincts, qualities and organizations to the present geography and climate of a region, may be a part only of the conditions which govern in every case the relations of the animate beings to their habitations. The past condition and changes of the globe and its inhabitants, throughout the whole period when the different beings were entering, each in succession, upon the scene, and all the future conditions and changes to the end of vast periods, during which they may be destined to exist, ought to be known, before we can expect to comprehend why certain types were originally selected for certain areas, whether of land or water." [Second visit to the United States, Vol. 1, p. 223.]

These remarks were printed before the establishment of the theory of evolution which now prevails among the naturalists of all countries and which has expanded our notions of the development of species by combining with our knowledge of the never-ceasing change and variations of animals and plants the laws governing the survival of the fittest under other environments and conditions; but the same mystery surrounds the peculiar limitation of certain genera to small geographical areas that did when Lyell wrote the above quotation. And the Darwinian theory offers us no assistance in accounting for such a fossil genus as *Agaricocrinus*. We may suppose that the various species could have been evolved, in the geological ages, from one type; but granting as actual facts all that we may suppose, yet the beginning of the genus and the ending remain absolutely unaccounted for even in theory. The development of all vegetable and animal life from a single monad is quite as chimerical as the special creation of each species out of the elements or from nothing. The invertebrate fossils, from the palæozoic rocks, afford no evidence to prove such fanciful imaginations. They show us that species were subject to such variations as we find now among living species, and they preserve for us the evidences of injury inflicted during life, showing that they recovered from their afflictions and withstood their vicissitudes, as similar grades of animals do now; but the abrupt appearance of a distinct genus, in a given geological age, and its confinement to a limited geographical area, and then its absolute extinction when it seems to have reached its largest size and most complete development, must be the result of some law or combination of laws which we not only do not understand, but of which we have no rational conception.

The fossils are the facts and the evidence in palæontology, and they have been collected in detached and remote places and stored in different states. From having observed a very limited number of these facts some authors have built cloudy systems and made useless speculations that are mere rubbish in the way of progress. The fossils are the indexes of nature; they must be observed with the eye, and from their appearance only can we become acquainted with the anatomy or hard parts of the animals. Until we are thoroughly acquainted with the anatomy of an animal, we are unprepared to discuss its physiology. Physiology is the word used by the medical men to express the science which unfolds the nature of life, the etymology and original acceptation of which means the doctrine of nature, but Treviranus, a German author, at a comparatively recent date, proposed the term "biology" for science of life instead of physiology, and naturalists who are not medical men use the word "biology" exclusively, and medical men generally retain the older name "physiology" to express one and the same thing. The biology is inseparable from the anatomy. The biological functions are manifested as the anatomical parts are developed and completed; they are modified with the afflictions of the anatomy; they decline and decay with it, and the biological functions cease when the softer anatomical parts are destroyed.

It was not uncommon for naturalists in the last century to arrange, from a few specimens in a museum, what they supposed represented the animal kingdom, in a successive series of development governed by the external appearances. They followed the chain, as they supposed, link after link, without a break, innocent of the fact that the internal comparative anatomy, when examined, would break the chain into fragments and wholly destroy the fancy of the gradual ascension and progression. We think we have seen in recent palæontological productions the arrangement of fossil shells, in successive series, from species to species, through different geological ages, as if they formed a chain in evolution, but it will separate, link after link, in like manner, under the glance of a scientist.

A knowledge of evolution followed the domestication of animals centuries ago but how and where it takes place is a subject of modern investigation. And we do not know how or where it has taken place, except as a result of observation and experiment. The theory of evolution does not account for anything, though an established fact may be consistent with the theory. All biological knowledge follows the discovery of the hard and soft parts of the anatomy of living animals, but among extinct fossil animals it is only to be inferred after a full knowledge of the hard parts found preserved. And *Agaricocrinus* is a good genus with which to make an illustration. We know that some crinoids, as *Eucalyptocrinus*, were permanently attached by roots that penetrate the mud, at the bed of the sea, like a forest tree penetrates the soil on land, that others, like *Anomalocrinus* attached roots to foreign objects, or were free, like *Pycnocrinus*, and though floaters could attach themselves by coiling the tapering ends of their columns around other objects; but we do not know to which of these divisions *Agaricocrinus* belonged. We know that the columns in some crinoids were square, others pentagonal and others round and that the column of *Agaricocrinus* was round; but we do not know what significance, if any, in the line of development, is to be attached to the form of the column, its structure, or the shape of the columnar canal. We know nothing of the internal anatomy of the calyx or head of *Agaricocrinus* and cannot trace the source of the genus, if it is to be found, in known species of earlier age or find the evidences of its survival, if it did survive, in later crinoidal forms.

We know by the three basals, absence of subradials, presence of primary radials and regular interradials, that *Agaricocrinus* must be classed, in the family *Actinocrinidæ*, which is established on the hard parts of the fossilized tests. and which has had no representative, so far as discoveries have progressed, since the Subcarboniferous age. They ante-date the Carboniferous period. An old English naturalist said, "Providence maintains and continues every created species; and we have as much assurance, that no races of animals will any more cease, while the earth remaineth, than seed time and harvest, cold and heat, summer and winter, day and night." But we have, on the contrary, every assurance that observation, discovery and study has offered, not only that the forty-two species of *Agaricocrinus* were confined to the geological ages, from which they have been described, but that the genus and the entire family of genera to which it belonged, so far as the biological part or the physiological functions of the animals are concerned, were annihilated absolutely from the face of the earth, in the Subcarboniferous period of geological time. They were not annihilated at the same time nor by any convulsion of nature. Instead of one species graduating into another, by improvement or decline, which may possibly have been the case, in some instances of which we have no proof, the general rule was that one species became extinct at one time and place, and another became extinct at another time and at another place, and, in this way, not only the forty-two species which are now known were obliterated, but all the unknown species belonging to the genus, and all allied genera which belonged to the same family were annihilated before the Coal Measures or Carboniferous period.

BATOCRINUS SHARONENSIS, n. sp.

Plate I, Fig. 7, azygous side view; Fig. 8, opposite view; Fig. 9, lateral view.

Species medium size, somewhat biturbinate. Calyx funnel shaped, rapidly expanded at the arms, a little less than twice as wide as high. No radial ridges, surface plane and smooth or, possibly, finely granular. Ambulacral openings directed a little above a horizontal line, and not visible in a basal view. An ovarian pore on each side of the pair of arms opposite to the azygous area, and they are all we have detected in two finely preserved specimens.

Basals form a disc about four times as wide as high. It bears a slight band and has an hemisperical depression for the attachment of the column. First primary radials large and wider than long, three hexagonal, two heptagonal. Second and third primary radials together smaller than the first. Second primary radials quadrangular, two or three times as wide as long. Third primary radials very little larger than the second, pentagonal, axillary, and in the ray opposite the azygous area bears upon each upper sloping side three secondary radials, which gives to this ray two arms. In each of the lateral rays the third primary radial bears upon each upper sloping side two secondary radials, the last ones being axillary, and bearing upon each upper sloping side two tertiary radials, which gives to each of these rays four arms. The third primary radial on each side of the azygous area bears upon the distal side three secondary radials and upon the proximal side two secondary radials, the last being axillary, and bearing upon each upper sloping side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen arms in this species. The arm formula is 3+4+2+4+3.

There are two plates in each regular interradial area, the first one is nearly as large as a first primary radial, and the second one is quite small and cut off from the vault by the union of two secondary radials, or two tertiary radials, in each adjacent ray. In the azygous area there are seven plates. The first one is in line with the first primary radials and as large as either of them. It is followed by three rather large plates, in the second range, and above these upon the right side and superior part of the middle one there are two plates, one of which is followed by a small plate that separates the tertiary radials and unites with the plates of the vault.

The vault is unsymmetrical. It is most tumid above the four armed rays and somewhat longitudinally depressed on the azygous side. The plates are convex, and there is a large subcentral proboscis.

The shape of the vault reminds one of the vault in *Batocrinus pyramidatus*, but the two species are so widely separated, in all the material parts of the structure, that no comparison is necessary. In structure it comes nearer *Batocrinus cognatus* than to any other species, though the arm formulas are different and there are more secondary and tertiary radials in this species than in that one. In general appearance there is very little resemblance between the two species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in the southwestern part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SCITULUS n. sp.

Plate 1, Fig. 10, azygous side; Fig. 11, opposite view.

Species medium size, biturbinate. Calyx obconoidal, about one-fourth wider than high. No radial ridges. Plates very slightly convex except the first primary radials and first azygous plate, each of which bears a central node. Ambulacral openings directed a little above a horizontal line. No ovarian pores discovered.

Basals form a round cup about twice as wide as high. It bears a well-defined band, and has an hemispherical depression for the attachment of the column. First primary radials large, a little longer than wide, three hexagonal, two heptagonal. Second and third primary radials together not as large as the first. Second primary radials quadrangular, about twice as wide as long. Third primary radials very little larger than the second, one heptagonal, two hexagonal, two pentagonal, axillary, and, in the ray opposite the azygous area, bears upon each upper sloping side two secondary radials, which gives to this ray two arms. In each of the other rays the third primary radial bears, upon each upper sloping side, a single secondary radial. which is comparatively large, axillary and bears upon each upper sloping side a single tertiary radial, except, in the ray adjoining the azygous area, where there are two tertiary radials, which gives to each of four rays four arms. There are, therefore, eighteen ambulacral openings to the vault, in this species. The arm formula is $4+4+2+4+4$. There is a small intercalated plate above the third primary radial, in the ray on the right of the azygous area, in the specimen illustrated. It is this intercalated plate that makes the third primary radial heptagonal. We suppose this feature to be abnormal, and, therefore, not of specific importance.

There are two plates, in each regular interradial area, one large, the other small and cut off from all connection with the vault by the union of the radials above. In the azygous area there are eight plates. The first one is in line with the first primary radials and of about the same size. It is followed, in the second range, by three plates, and above these there are four smaller ones that are cut off from any connection with the plates of the vault by the union of the second tertiary radials above them.

The vault is nearly as large as the calyx and bears a very large central proboscis. It is covered by numerous slightly convex polygonal plates.

This species has its affinities with *B. affinis*, which is a twelve armed species, *B. approximatus*, a thirteen armed species, *B. verneuilianus*, a fourteen armed species, *B. variabilis*, a fifteen armed species, *B. cognatus*, a sixteen armed species, and *B. consanguineus*, a twenty armed species. It will be distinguished from these species by the arm formula and eighteen ambulacral openings to the vault.

Found by R. A. Blair, in the Burlington Group, near Sharon, in the southwest part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS SENEX, n. sp.

Plate I, Fig. 12, azygous side; Fig. 13, opposite view of same specimen; Fig. 14, summit view of another specimen.

Species below medium size, biturbinate. Calyx obconoidal, most rapidly spreading at the arms, more than one and a half times as wide as high. No radial ridges, but depressed at the upper part of the interradial areas leaving the radial series projecting at the bases of the arms. Plates smooth, the larger ones slightly convex. Ambulacral openings not visible in a basal view, but conspicuous in a summit view. An ovarian pore on each side of the radial series opposite the azygous area, others not discovered.

Basals form a low expanding cup nearly four times as wide as high and having an hemispherical depression below, for the attachment of the column, which has a diameter equal to the truncated end of the calyx. No basal rim. First primary radials large, nearly as long as wide, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long, and less than half as large as the first. Third primary radials about half as large as the first, the two adjoining the azygous area hexagonal, the other three pentagonal, and in the ray opposite the azygous area supports on each upper sloping side two secondary radials, which gives to this ray two arms. In each of the lateral rays the third primary radial bears upon one upper sloping side three secondary radials and upon the other two secondary radials, the last being axillary and supporting, on each upper sloping side, a single tertiary radial, which gives to each of these rays three arms. In the ray on each side of the azygous area, the third primary radial bears upon the distal side three secondary radials and upon the proximal side two secondary radials, the last being axillary and bearing, upon one upper side, a single tertiary radial, and upon the other two tertiary radials, which gives to each of these rays three arms. There are, therefore, fourteen arms in this species. The arm formula is 3+3+2+3+3.

In each of three regular interradial areas, there are three plates, one in the first range and two elongated plates in the second range, one of which connects with a plate belonging to the vault. In the other regular area there are four plates, one in the first range, two in the second and one in the third, which unites with the plates of the vault. In the azygous area there are seven plates. The first one is in line with the first primary radials and about the same size. It is followed by three plates in the second range and three in the third range, the middle one of which connects with the plates of the vault.

The vault is conical and bears a large central proboscis. It is covered with numerous convex polygonal plates.

This species, no doubt, has some affinity with *B. verneuilianus*, but not much with any other fourteen-armed species. In general appearance it does not bear much resemblance to *B. verneuilianus*, because the form and proportion of the plates are so different; beside the interradial areas and number of interradial plates are different and the number of secondary and tertiary radials do not agree, though each has fourteen ambulacral openings to the vault.

Found by R. A. Blair, in the Burlington Group, near Sharon, in Southwest Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RELIQUUS, n. sp.

Plate I, Fig. 15, basal view; Fig. 16, azygous side; Fig. 17, summit view.

Species below medium size, biturbinate or somewhat wheel-shaped. Calyx very rapidly spreading at the arms, where it is more than twice as wide as high. No radial ridges, but the radial series are somewhat lobed and project at the margin so as to notch the circumference at the interradial parts. Plates finely granular, the larger ones slightly convex. Ambulacral openings directed horizontally and not visible in a basal view. No ovarian pores discovered.

Basals form a very short rapidly expanding cup four times as wide as high. No basal rim. First primary radials larger than the second and third together, three hexagonal, two heptagonal. Second primary radials quadrangular, two or three times as wide as long. Third primary radials a little larger than the second; each one of them is hexagonal, axillary, and in each of the lateral rays and in the ray opposite the azygous area support, on each upper sloping side, two secondary radials, which gives to each of these three rays two arms. In the ray on each side of the azygous area the third primary radial supports, on the distal side, two secondary radials, and on one of the proximal sides two secondary radials, the last being axillary and supporting on each upper side a tertiary radial, and on the other proximal side one secondary radial, which is axillary, and supports on each upper side a tertiary radial, which gives to each of these two rays three arms. There are, therefore, twelve arms in this species. The arm formula is 3+2+2+2+3.

In each of three regular interradial areas there are three plates—one in the first range and two in the second, both of which connect with the plates of the vault; in the other area there are four plates, two of which connect with the plates of the vault. In the azygous area there are seven plates. The first is in line with the first primary radials and fully as large as either of them. It is followed by three plates in the second range, the middle one of which connects with the plates of the vault. On the left of the upper part of this elongated plate there is one plate that connects with the vault, and on the right there are two plates, one of which connects with the vault. There are, therefore, three azygous plates, in a wide area, that connect with the vault.

The vault is pyramidal, by reason of being depressed in the interradial areas, and bears a large central proboscis. It is covered with convex, polygonal plates.

This species is so distinct from all other twelve-armed species, in general appearance as well as in the general structure, that no comparison is necessary.

Found by R. A. Blair, in the Burlington Group, near Sharon, in Southwest Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RUSTICELLUS, n. sp.

Plate I, Fig. 18, basal view; Fig. 19, same, magnified two diameters; Fig. 20, azygous side; Fig. 21, summit view.

We have three specimens of this species, one of which is twice as large as the one illustrated. The species, may, therefore, be said to be medium or slightly below medium in size, biturbinate or somewhat wheel-shaped, the larger specimen more wheel-shaped than the one illustrated. Calyx very rapidly spreading at the arms; where it is from two to two and a half times as wide as high. No radial ridges, but the radial series are slightly lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates plane and finely granular. Ambulacral openings not visible in a basal view, but may be seen in a summit view. One ovarian pore on each side of each radial series may be plainly seen in the larger specimen, but only part of them can be seen in the specimen illustrated.

Basals form a short round disc, having an hemispherical depression for the attachment of the column. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, two or two and a half times as wide as long. Third primary radials larger that the second, two hexagonal, three pentagonal, axillary, and in the ray opposite the azygous area supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In one lateral ray the third radial bears two secondary radials on each upper side, and in the other only one, the last being axillary and supporting upon each upper side two tertiary radials, which gives to each of these rays four arms. In the ray on each side of the azygous area the third primary radial supports, on the distal side, three secondary radials, and on one of the proximal sides one axillary secondary radial, which bears on each side two tertiary radials and on the other proximal side two secondary radials, the last being axillary and supporting on each upper side two tertiary radials, which gives to each of these rays three arms. There are, therefore, sixteen ambulacral openings to the vault in this species. The arm formula is 3+4+2+4+3.

There are three plates in each regular interradial area, one, followed by two, which are cut off from all connection with the vault by the union of the radials above them. There are only four plates in the azygous area. The first one is in line with the first primary radials and about the same size. It is followed by three plates, the middle one being quite large, but cut off from the vault by the union of the tertiary radials above it.

The vault is nearly as large as the calyx and bears a small central proboscis. It is covered with convex, polygonal plates and is slightly lobed over the ambulacral canals.

It is a marked species in its general appearance and need not be compared with any other sixteen-armed species to distinguish it.

Found by R. A. Blair, in the Burlington group, near Sharon, in Southwestern Missouri, and now in the collection of S. A. Miller.

BATOCRINUS RESERVATUS, n. sp.

Plate 1, Fig. 22, basal view magnified two diameters; Fig. 23, same natural size; Fig. 24, azygous side; Fig. 25, summit view.

Species below medium size, biturbinate, wheel-shaped. Calyx very rapidly spreading at the arms, where it is twice as wide as high. No radial ridges, but the radial series are lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates plane and smooth, or finely granular. Ambulacral openings directed upward and not visible in a basal view, but fully exposed in a summit view. An ovarian pore may be seen on each side of each radial series, the opening is through the last radial and is small so as not to be very distinct.

Basals form a short, round, expanding cup, twice as wide as high, and having an hemispherical depression for the attachment of the column. First primary radials as large as the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials, quadrangular, about twice as wide as long. Third primary radials a little larger than the second, three hexagonal, two pentagonal, axillary, and, in the ray opposite the azygous area, supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In one of the lateral rays, the third primary radial supports, on each upper side, two secondary radials, the last ones axillary and supporting, on the distal sides, two tertiary radials, and, on the proximal sides, one, which gives to this ray four arms. In the other lateral ray, there are three secondary radials on one side, and two on the other, the last one being axillary and supporting, on each side, two tertiary radials, which gives to this ray three arms. In the ray, on each side of the azygous area, the third primary radial bears, upon each distal side, three secondary radials, and, upon each proximal side, two secondary radials, the last being axillary and supporting on each upper side, two tertiary radials, which gives to each of these rays three arms. There are, therefore, fifteen arms in this species. The arm formula is 3+4+2+3+3.

In each regular interradial area there are three plates—one in the first range, followed by two elongated plates in the second range that unite with the plates of the vault. In the azygous area there are four plates. The first one is in line with the first primary radials and about the same size. It is followed by three large plates, the middle one of which is much elongated and unites with the plates of the vault.

Vault pyramidal by reason of the depressed interradial areas, nearly as large as the calyx, and bears a central proboscis. It is covered by convex, polygonal plates.

This species bears little or no resemblance to any other fifteen-armed species. When compared with *B. rusticellus* above described, it will be seen that it bears sixteen arms and that neither the azygous area nor any of the interradial areas connect with the vault, while this species bears fifteen arms and all the areas are widely connected with the vault. A close inspection shows a difference in structure in nearly all respects. Like differences will be found when compared with other species.

Found by the veteran collector, R. A. Blair, to whom science is so much indebted for unremitting labor, in the Burlington Group, near Sharon, in the Southwestern part of Missouri, and now in the collection of S. A. Miller.

BATOCRINUS ROTULIFORMIS, n. sp.

Plate I, Fig. 26, basal view magnified two diameters; Fig. 27, same natural size. Plate II, Fig. 1, azygous view; Fig. 2, summit view.

Species below medium size, biturbinate, wheel-shaped. Calyx curving outward from the base to the arms, more than twice as wide as high. No radial ridges, but the radial series are lobed and project at the margin so as to notch the circumference at the interradial spaces. Plates convex and finely granular. Ambulacral openings directed slightly above an horizontal line, not visible in a basal view, but may be seen in a summit view. No ovarian pores detected, and probably they open through the first arm plate.

Basals form a short hexagonal disc five times as wide as high, notched at the sutures, and having an hemispherical depression for the attachment of the column. First primary radials not as large as the second and third together, about twice as wide as long, three hexagonal and two heptagonal. Second primary radials quadrangular, from three to five times as wide as long. Third primary radials about one half larger than the second, four hexagonal, one heptagonal, axillary, and the ray opposite the azygous area ;upports, on each upper sloping side, three secondary ralials, which gives to this ray two arms. In each of the lateral rays and in the ray on the right of the azygous area the third primary radial supports, upon one upper side, three secondary radials and upon the other two, the last one being axillary and supporting, on each upper side, two tertiary radials, which gives to each of these rays three arms. In the ray on the left of the azygous area the third primary radial bears, upon each upper sloping side, two secondary radials, the last being axillary and supporting, on each upper sloping side, two tertiary radials, which gives to this ray four arms. There are, therefore, fifteen arms in this species. The arm formula is 3+3+2+4+3.

In each regular interradial area, there are three plates, one in the first range followed by two elongated plates, in the second range, that unite with the plates of the vault. In the azygous area there are seven plates. The first one is in line with the first primary radials and about the same size. It is followel by three plates, in the second range, and these by three plates, in the third range, all three of which unite with the plates of the vault.

Vault pyramidal by reason of the depressed interradial areas, larger than the calyx, and bears a large central proboscis. It is covered by large convex, polygonal plates.

This species is most nearly related to *B. reservatus*, above described, from which it is distinguished, by the hexagonal disc, formed by the basal plates, instead of a round expanding cup; by the azygous area, which has seven plates, three of which unite with the plates of the vault, instead of four plates, only one of which connects with the vault; by the larger vault which is covered with larger and more convex plates; and by the arm formula which is 3+3+2+3 4, instead of 3 4 2 3 3. There are minor differences as may be seen by comparing the descriptions. It need not be compared with any other species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

BATOCRINUS (?) RUSTICUS, n. sp.

Plate II, Fig. 3, basal view magnified two diameters; Fig. 4, same natural size; Fig. 5, azygous side; Fig. 6, summit view.

Species rather below medium size, calyx and vault somewhat equal and together somewhat lenticular. Ambulacral openings directed horizontally and not visible in either a basal or summit view. Calyx very rapidly spreading from the basal disc, slightly depressed in the interradial areas, and lobed over the radial series. No radial ridges, but the radial series project so as to notch the circumference at the interradial spaces. Ovarian pores not discovered.

Basal plates very short and form a hexagonal disc bearing a concave depression for the attachment of the column. First primary radials larger than the second and third together, wider than long, three hexagonal, two heptagonal. Second primary radials quadrangular, from four to six times as wide as long. Third primary radials a little larger than the second, pentagonal, axillary, and the ray opposite the azygous area, supports, on each upper sloping side, three secondary radials, which gives to this ray two arms. In each of the other four arms, the third primary radial supports, on each upper sloping side, two secondary radials, the last being axillary and supporting, on each upper sloping side, two tertiary radials, which gives to each of these rays four arms. There are, therefore, eighteen ambulacral openings to the vault, in this species. The arm formula is 4 4 2 4 4.

There are three plates in each regular interradial area, one in the first range, followed by two narrow elongated plates, in the second range, that unite with the plates of the vault. In the azygous area there are six plates. The first is in line with the first primary radials and narrower and smaller than either of them. It is followed by three plates, in the second range, and two in the third range, that unite with the plates of the vault.

Vault convex and bears a rather large, convex, central plate, surrounded by seven plates, three of which adjoin the small plates that surround the azygous orifice. The plates over the ambulacral canals are large and tumid, those in the interradial areas smaller and less convex. The azygous orifice is small, somewhat elevated, and subcentral.

In the subpentagonal outline of the calyx, short form, and in the character of the vault this species allies itself with *Agaricocrinus*; but in the plates of the calyx, and in their arrangement, it is a true *Batocrinus*. If the arms were preserved, we might be disposed to refer it to *Agaricocrinus*, notwithstanding the plates and form of the calyx. We have referred it to *Batocrinus* with doubt. If there has ever been a link discovered that connects *Batocrinus* with *Agaricocrinus*, by any chain of development, it is to be found, in this species. All authors who lay stress upon the characters of the vault will unhesitatingly refer this species to *Agaricocrinus*. But no eighteen armed *Agaricocrinus* has ever been found, in the Burlington Group, and only one in the Keokuk, and it is a pronounced *Agaricocrinus*. Typical *Agaricocrinus* appear in the Chouteau with ten and twelve arms and they are quite as early as any *Batocrinus*. *Batocrinus* with eighteen and more arms are common in the Burlington. This cannot be the species through which *Batocrinus* developed into *Agaricocrinus*, nor through which *Agaricocrinus* developed into *Batocrinus*, because it is not found in rocks early enough for such transition. It is only indicative of an apparent affinity, when both genera were in the mature state of their existence. The stratigraphical position with the eighteen armed structure is in favor of classifying it with *Batocrinus*.

Found in the Burlington Group, by R. A. Blair, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

BATOCRINUS DOUGLASSI, n. sp.

Plate II, Fig. 26, view opposite the azygous area.

Species medium size, biturbinate. Calyx obconoidal, about twice as wide as high. Radial ridges rounded, and all the plates radiately sculptured. Truncated only the diameter of the column.

Basals form a very short hexagonal disc. First primary radials much wider than long, three hexagonal, two heptagonal. Second primary radials about half as large as the first, and about half as long as wide, quadrangular. Third primary radials larger than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial which is axillary, and, upon the distal sides, support four tertiary radials, before the arms become free; upon each proximal side there is a single tertiary radial, which is axillary and supports three quaternary radials before the arm becomes free.

There are, therefore, six arms in each of the three rays preserved, in our specimen. The ray on each side of the azygous area is injured, but, we think, from appearances, we can safely call this a thirty armed species. After the arms become free they are composed of a double series of interlocking plates.

The first regular interradial is very large and it is followed by either one or two small plates which are cut off from all connection with the vault by the union of the tertiary radials above. The azygous plates cannot be determined in our specimen.

The vault is conical but smaller than the calyx and bears a long, central proboscis, which is broken off at the top of the specimen illustrated.

This is a marked species, and, if we were to guess at the age of the rocks from which it came, from an examination of the single specimen, we would be inclined to say the Keokuk Group. But some of the associated fossils figured and described, in this Bulletin and Bulletin No. 10, have the aspect of Burlington fossils. Some of the Government publications have called the rocks Carboniferous, but no such fossils were ever found in the Carboniferous rocks in any part of the world. When we described the forms in Bulletin No. 10, we had no hesitation in saying they came from the Subcarboniferous and we can now be certain that they are from the lower half of the Subcarboniferous. It is probable that all the fossils we have examined are not from the same layers and some may belong to the Burlington and others to the lower part of the Keokuk Group. At present we are inclined to refer them to the Upper Burlington or Lower Keokuk, because none of them are from rocks lower than the Burlington or higher than the Keokuk, and we do not know whether they are or are not from rocks of the same geological age.

Found by Earl Douglass, in whose honor we have proposed the specific name, on Bridger Mountains, near Bozeman, Montana, and now in the collection of S. A. Miller.

DORYCRINUS SUBOVIFORMIS, n. sp.

Plate II, Fig. 7, azygous side; Fig. 8, opposite view; Fig. 9, summit view.

Species medium size, calyx and vault together subovate. Calyx urn-shaped, narrowly rounded below. No radial ridges, but the radial series project moderately at the arm bases, so as to notch the circumference at the interradial spaces. Ambulacral openings directed upward, so as to be wholly visible in a summit view, but cannot be seen in a basal view. Plates plane and smooth. No ovarian pores discovered, though our specimens are in a fine state of preservation.

Basal plates form a rounded expanding cup with a small concave depression for the attachment of the column. First primary radials large, as long as wide, three hexagonal, two heptagonal. Second primary radials hexagonal, about as long as wide, and having the appearance of the second primary radials in *Actinocrinus*. Third primary radials smaller than the second, the two adjoing the azygous area hexagonal, the other three heptagonal, and in the ray opposite the azygous area, bears, on each upper sloping side, two secondary radials, which gives to this ray two arms. In each of the other rays, the third primary radial supports, on each upper side, two secondary radials, the last ones being axillary and bearing, on each upper sloping side, a small tertiary radial, which gives to each of these rays four arms or four small ambulacral openings to the vault. There are, therefore, eighteen arms in this species. The arm formula is 4+4+2+4+4.

In each regular interradial area, there are seven plates, one in the first range, two in the second, two in the third and two in the fourth, that separate the arms, and unite with the plates of the vault. The azygous area is very large and contains eighteen plates. The first one is in line with the first primary radials and of about the same size. It is followed by three, in the second range, five in the third range, five in the fourth range, and four in the fifth range, that connect with the plates of the vault. One of the plates in the last range appears as a small intercalated plate.

The vault is rounded or subhemispherical and perfectly smooth. There is a large plate at the summit which is surrounded by seven somewhat smaller plates, though unequal in size. These are surrounded by two ranges of smaller plates and a few intercalated ones. There is a small azygous orifice directed horizontally, at the lower part of one of the plates, in the range of seven, that surrounds the central plate.

This is a very peculiar species, partaking of some of the characters of *Actinocrinus* and some of the characters of *Dorycrinus* and is referred to the latter, because its affinities seem to be stronger in that direction, notwithstanding its smooth vault, than they are with the former. We have two other specimens, which seem to agree with this species, though they are pressed somewhat out of shape, except in one particular. They have three ambulacral openings to the vault, in the ray opposite the azygous area, which gives to each nineteen arms. In a better state of preservation they might show other differences, and may belong to another closely related species.

Found by R. A. Blair, in the Burlington Group, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

STEGANOCRINUS SHARONENSIS, n. sp.

Plate II, fig. 10, azygous side; fig. 11, opposite view; fig. 12, vault.

Species small. Calyx obpyramidal, rather broadly truncated, pentagonal as seen from below or above. Plates thick, nodose, pyramidal. Column large, canal small.

Basals form a short, hexagonal cup, deeply notched at the sutures. Plates below somewhat cuneiform. First primary radials rather large, nodose, wider than long, three hexagonal, two heptagonal. Second primary radials about two-thirds as large as the first, sculptured in like manner, wider than long, hexagonal. Third primary radials smaller than the second, pentagonal, axillary and support on each upper sloping side a single secondary radial which is axillary, and beyond which the plates are not preserved in our specimens. There do not appear to be more than ten openings to the vault, but they are large and the axillary plates show twenty arms.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no dividing line between the vault and calyx. The regular interradial areas are not uniform. The first plate is followed in each area by two smaller plates in the second range. In each of two areas there are two plates in the third range, and in the other areas three plates, and these separate the arms and unite with plates that may be regarded as vault plates. In the azygous area the first plate is in line with the first primary radials and about the same size. It is followed by two plates in the second range, three in the third range, three in the fourth range, and three in the fifth range, that separate the arms.

The vault is only slightly convex and only moderately elevated over the ambulacral canals and bears a subcentral proboscis. It is covered with convex and nodose polygonal plates.

This species might be referred to *Actinocrinus*, as it is about on the dividing line between that genus and *Steganocrinus*. The position of the plates preserved indicates that the arms were rigid and directed horizontally, and it is for that reason alone that we refer it to the latter genus.

Found by R. A. Blair in the Burlington Group, near Sharon, in southwestern Missouri, and now in the collection of S. A. Miller.

STEGANOCRINUS ALBERSI, n. sp.

Plate II, fig. 13, azygous side; fig. 14, opposite view; fig. 15, summit view; fig. 16, basal view.

Species medium or below medium size. Calyx obpyramidal, moderately truncated, pentagonal as seen from above or below. Plates thick, radiately sculptured, and the larger ones bear central nodes.

Basals form a short, sculptured, hexagonal cup, notched at the sutures and having an hemispherical depression for the attachment of the column. First primary radials very large, about as wide as long, three hexagonal, two heptagonal. Second primary radials less than half as large as the first, rather wider than long, hexagonal. Third primary radials smaller than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and beyond which the plates are not preserved in our specimen. There are twenty ambulacral openings to the vault.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no dividing line between the vault and the calyx. The regular interradial areas are not uniform. The first plate is followed, in each area, by two plates in the second range, which connect with the plates covering the sides of the ambulacral channels and with the plates of the vault. In the azygous area the first plate is in line with the first primary radials, but somewhat smaller. It is followed by two plates in the second range and these by four in the third range that unite with the plates of the vault and those covering the ambulacral channels.

The vault is only slightly convex and bears a central proboscis. It is covered with convex and nodose polygonal plates.

This species is distinguished from *S. sharonensis* by the character of the surface ornamentation, by having proportionally larger plates and fewer plates in the azygous and regular interradial areas. It is very clearly a true *Steganocrinus*.

Found in the Burlington Group, at Burlington, Iowa, and now in the collection of A. Albers, in whose honor we have proposed the specific name.

STEGANOCRINUS GRIFFITHI, n. sp.

Plate II, Fig. 17, azygous side; Fig. 18, opposite view; Fig. 19, basal view; Fig. 20, summit view.

Species small. Calyx obpyramidal, broadly truncated, pentagonal as seen from above or below. Plates nodose, pyramidal.

Basals form a short, hexagonal cup, deeply notched at the sutures. First primary radials large, nodose, pyramidal, wider than long, three hexagonal, two heptagonal. Second primary radials about half as large as the first, wider than long, hexagonal. Third primary radials smaller than the second, pentagonal, axillary, and beyond these plates our specimen is not preserved. Ten ambulacral openings penetrate the vault.

The interradial areas all graduate up into the vault and over the ambulacral channels so as to leave no dividing line between the vault and calyx. The first regular interradial is followed by two plates that unite with two plates that belong to the vault and two that cover part of the ambulacral canals. In the azygous area, the first plate is in line with the first primary radials, but somewhat smaller. It is followed by two plates in the second range and three in the third that unite with the plates of the vault and those covering part of the ambulacral channels.

The vault is only slightly convex and bears a central proboscis. It is covered with rather large convex plates.

This species most resembles *S. sharonensis*, from which it is distinguished by the character of the ornamentation, by the form of the basal plates, and by having a less number of plates in the interradial areas and upon the vault. The vaults are so different that the two species will not be taken for each other.

Found in the Burlington Group, at Burlington, Iowa, by Dr. H, G. Griffith, formerly of that place, but now residing in Philadelphia. We take pleasure in dedicating this species to the learned doctor and naturalist who discovered it. It is now in the collection of Mr. A, Albers.

STEGANOCRINUS BLAIRI, n. sp.

Plate II, Fig, 21, view opposite the azygous side, all the arms, except one, broken off at the calyx; Fig. 22, basal view, part of the sutures destroyed.

Species medium size. Calyx urn-shaped, transverse section subpentagonal. Plates thick, radiately sculptured, the larger ones having a small central node.

Basals form a subhexagonal, sculptured disc four or five times as wide as high. First primary radials a little wider than long, three hexagonal, two heptagonal. Second primary radials only a little smaller than the first, hexagonal. Third primary radials a little smaller than the second, pentagonal, axillary, and support on each upper sloping side a single secondary radial, which is axillary, and supports on each upper sloping side tertiary radials. Two tertiary radials are preserved in our specimen and there is a small plate resting in the angle between the two secondary radials that separates the first proximal tertiary radials. This species has at least twenty ambulacral openings to the vault.

The first regular interradial in each area is followed by a range of plates, two of which are directly above it and unite with the plates of the vault, and upon each side of these the plates are continued out upon the side of the radial series and cover part of the ambulacral channel. In the azygous area, the first plate is in line with the first primary radials and about the same size. It is followed by two plates in the second range, above which there are three plates that unite with the plates of the vault and upon each side of these the plates are continued out upon the side of the radial series and cover part of the ambulacral channel.

The vault is highly convex, much elevated over the ambulacral canals, and bears a large central proboscis. It is covered by convex and nodose, polygonal plates.

This species is a true *Steganocrinus* and very readily distinguished from all that have been heretofore described.

Found by R. A. Blair, in whose honor we have proposed the specific name, in the Burlington Group, near Sharon, in Southwestern Missouri, and now in the collection of S. A. Miller.

ACTINOCRINUS SENECTUS, n. sp.

Plate II, Fig. 23, azygous side; Fig. 24, opposite view; Fig. 25, summit.

Species medium size. Calyx obpyramidal, truncated only the diameter of the column, transverse section subpentagonal. Radial ridges sharply angular, interradial plates convex. Diameter about one fourth more than the height, column round.

Basals form a round cup about three times as wide as high. First primary radials large, about as long as wide, three hexagonal, two heptagonal. Second primary radials rather less than half as large as the first, wider than long, hexagonal. Third primary radials smaller than the second, about twice as wide as long, pentagonal, axillary, and bear upon each upper sloping side a single secondary radial. The secondary radials are thick strong plates and stand out from the calyx. There are ten ambulacral openings to the vault. Arms unknown.

The interradial areas connect with the vault, and the plates graduate into each other. They are not uniform, and the plates vary in the regular areas from five to seven. In one area, there is one plate followed by two, in the second range, and two in the third range, in another area, there are three plates in the second range, and above which there are three more. The azygous area is very large and contains fifteen large plates. The first one is in line with the first primary radials and somewhat smaller than either of them. It is followed by two plates in the second range, three in the third range, and five in the fourth range, above which there are four plates that may be classed in this area, though they interlock with those belonging to the vault.

The vault is depressed convex and covered with a few very large tumid plates. The central plate is large and surrounded by seven large plates. The azygous orifice is outside of the circle of seven plates. The plates over the ambulacral channels are large and those in the slightly concave interradial areas smaller.

The species is congeneric with *Actinocrinus chouteauensis*, and neither of them are typical *Actinocrinus*. The calyx is that of an *Actinocrinus*, and the vault is more like that of an *Agaricocrinus*. Under these circumstances, we think they should be referred to *Actinocrinus*, as the differences are not sufficient to cause them to be referred to a new genus. They do not belong to *Physetocrinus* even if that genus is worth retaining, which may be doubtful. They have no resemblance to *Amphoracrinus*, which is a genus having a quadrangular second primary radial, which allies the calyx to *Batocrinus*, and which has a ponderous high vault and large proboscis. No true *Amphoracrinus*, as represented by the type, *A. gilbertsoni*, or the allied species, *A. atlas*, has ever been found in America, and probably all American species that have been referred to *Amphoracrinus* belong to *Actinocrinus*.

Found by R. A. Blair, in the Chouteau limestone, at Sedalia, Missouri, and now in the collection of S. A. Miller.

FAMILY DOLATOCRINIDÆ.

DOLATOCRINUS NEGLECTUS, n. sp.

Plate II, Fig. 27, basal view; Fig. 28, summit; Fig. 29, side view.

Species full medium size. Calyx low, basin shaped, a little more than three times as wide as high, broadly and deeply concave below, the depression including the second radials, and having a deep funnel-shaped columnar pit which is bounded by a pentagonal rim. The angles of the pentagon unite with the radial ridges, and the funnel within the rim is smooth or without ornamentation and extends as high as the top of the calyx. Radial ridges within the concavity. angular elevations, but above, they are broken into elongated angular nodes by the sutures between the plates. The surface of the interradial areas is radiately sculptured from a central pit, instead of from a central node; and other parts of the calyx are irregularly sculptured. Column round and attached at the bottom of the funnel-shaped columnar pit.

Basals form a round cup deeply inserted in the calyx where they rise as high as the top of the calyx. The mouth of the cup is about one-third wider than the diameter of the column. First primary radials as long as wide, smooth below the pentagonal rim and sculptured above it. Second primary radials twice as wide as long, quadrangular. Third primary radials larger than the second, pentagonal axillary, and, in each of four of the rays, bears upon one upper sloping side four secondary radials, and upon the other a single secondary radial which is axillary and supports on each upper side three tertiary radials, which arrangement gives to each of these rays three arms. In the other ray, the third primary radial bears upon each upper sloping side a single secondary radial which is axillary, and one of them bears upon each upper sloping side three tertiary radials and the other bears upon one sloping side three tertiary radials and upon the other, two, the last of which is axillary and bears upon each upper side two quaternary radials, which gives to this ray five arms. There are, therefore, seventeen arms in this species. The arm formula is 3+5 3 3 3.

There seem to be only two interradials in each area. The first is medium, in size, for species, in this genus, and the second is smaller and cut off from connection with the vault by a union of the radial plates. Or, at least, we cannot find any sutures for the small plates that usually unite these areas with the vault. The azygous area is substantially like the other areas.

The vault is highly convex and bears a short subcentral proboscis. The vault is covered by a few large, plane plates. There are two elongated, curved, ovarian apertures in each interradial area, and two within each radial series which gives to this species twenty ovarian apertures.

This species most resembles *D. hammelli*, from which it is distinguished by having seventeen instead of sixteen arms. It has also an increased number of tertiary plates as well as the quaternary plates. The interradial areas are connected with the vault by two plates in that species, which do not, as it appears, exist in this species. There are other minor differences.

Found by Geo. K. Greene in the Hamilton Group near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

STEREOCRINUS INDIANENSIS n. sp.

Plate III, Fig. 13, view of a calyx showing all the plates ; Fig. 14, lateral view, showing height of calyx; Fig. 15, view of a silicified specimen in the usual condition.

Species small. Calyx flat with the exception of raised, rounded, radial ridges. The surface of the plates is delicately sculptured.

The basal plates are small, and form a small, more or less, conical elevation in the interior. The first primary radials are about twice as large as the second. The second are axillary and support on each upper sloping side a series of secondary radials. As many as five secondary radials are preserved in some of the rays. There is no other bifurcation of a ray. There are, therefore, only ten arms in this species. The first regular interradial plate is elongated and has ten sides. It is followed by two elongated plates in the second range, beyond which we have been unable to see the sutures. In the inter-secondary areas one plate is followed by two in the second range, and those by three in the third range, beyond which silicification has destroyed the sutures in our specimens.

The vault is low, but our specimens are not preserved to throw any light upon it.

The greater number of specimens are found silicified, and it is rare to find the crinoidal structure exposed. It is a remarkable species and bears little or no resemblance to the type species. Indeed no one would suspect that they could belong to the same genus, without having compared them with the generic formula. The two primary radials in each species alone ally them with each other.

Found by Geo. K. Greene in the Hamilton Group, near Charlestown, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY RHODOCRINIDÆ.

RHODOCRINUS DOUGLASSI, n. sp.

Plate III, Fig. 1, azygous area on the left.

Species medium or above medium size. Calyx bowl-shaped, or subcylindrical, radial ridges not defined. Plates sculptured and more or less pyramindal. Basal cavity deep. Column medium size, round, and composed of plates of equal length.

Basals form a cone, within the calyx, into which the end of the column is inserted. Subradials slightly larger than the first primary radials and sculptured pyramidal. First primary radials pyramidal, heptagonal and hexagonal. Second primary radials about one fourth as large as the first, nearly as long as wide, pentagonal. Third primary radials about the size of the second, hexagonal, and support on each of two upper sides, the secondary radials. There are three secondary radials in each series, the first one being the larger and the last one being axillary. There is a plate, resting in the angle, formed at the juction of the first secondary radials, which has the appearance of belonging to a radial series and the third plate above being axillary. But here an explanation becomes necessary. Our specimen is injured, at this place, as shown in the illustration, and we cannot determine exactly how the arms attached. The ray we are describing is on the right of the azygous area and bears seven arms. The axillary third secondary radial on the right very clearly bears two arms and the axillary third secondary radial adjoining the azygous area bears upon one side an arm and upon the other two plates, the last one being axillary and supporting two arms. It leaves, therefore, two arms to be supported by the middle series of plates. This arrangement may be peculiar to this ray. The right lateral ray is not fully exposed, as the specimen is on a slab, but it appears to have only six arms, but one appears to follow the plate resting in the angle at the junction of the first secondary radials. The species, therefore, possesses between thirty and thirty-five arms. If the rays were uniform it would possess thirty-five arms, but another specimen on the same slab shows one ray very clearly possessing only six arms. The arms are small and composed of a double series of small interlocking plates that bear strong pinnules.

In the regular interradial area, shown, in the illustration, the first plate truncates a subradial, it is followed by two plates in the second range, three in the third, and three in the fourth, above which they are not disclosed. In the azygous area the first plate is twice as large as the first plate in the regular area and truncates a very large subradial. It is followed by four plates in the form of an arch the middle one of which is as large as the first plate in a regular area. There are also four plates, in the form of an arch, in the third range, the middle one of which is the larger and above these smaller plates graduate up into the vault.

The vault is not exposed in either of our specimens.

This is a strongly characterized species.

Found by Earl Douglass, in whose honor we have proposed the specific name, in the Upper Burlington or Lower Keokuk Group, on Bridger Mountains, near Bozeman, Montana, and now in his collection.

RHODOCRINUS BOZEMANENSIS, n. sp.

Plate III, fig. 2, side view.

Species rather below medium size. Calyx bowl-shaped, radial ridges not defined. Plates sculptured and more or less pyramidal. Basal cavity deep. Column medium size, round, and composed of plates of equal length.

Basals form a cone within the calyx, into which the end of the column is inserted. Subradials not any larger than the first primary radials, and entirely within the basal concavity. First primary radials pyramidal, heptagonal and hexagonal. Second primary radials about one-third as large as the first, nearly as long as wide, pentagonal. Third primary radials about the size of the second, hexagonal, and support on each of two upper sides the secondary radials. Our specimen is slightly injured at the base of the arms, but as near as can be determined there are three secondary radials in each series, the last being axillary and supporting the arms. This gives twenty arms to the species. The arms are composed of a single series of cuneiform plates, each one of which bears a long, strong pinnule.

In the regular interradial area, shown in the illustration, the first plate is as large as a first primary radial, truncates a subradial, and is followed by two somewhat smaller plates in the second range, two quite small plates in the third range, and one or more in the fourth range. Above the fourth range the plates are not accurately determined. This is evidently a regular interradial area. The other areas and the vault are unknown.

This species will be readily distinguished from *R. douglassi* by being a smaller species, having only twenty arms instead of thirty or more, and by the single series of arm plates instead of a double series.

Found by Earl Douglass in the Upper Burlington or Lower Keokuk Group, on Bridger Mountains, near Bozeman, Montana, and now in his collection.

RHODOCRINUS BRIDGERENSIS, n. sp.

Plate III, fig. 3, side view.

Species below medium size. Calyx globular or subspheroidal. No radial ridges. Plates granular, not sculptured. Basal cavity moderately deep, column very large, composed of very short pieces. This species has twenty arms. The arms are small.

This species is distinguished by the globular calyx, large column and small arms.

Found in the Burlington or Keokuk Group by Earl Douglass, in Bridger Mountains, Montana, and now in his collection.

PLATYCRINUS BOZEMANENSIS, n. sp.

Plate III, Fig. 5. view showing the arms and calyx except a small piece which is broken off.

Species medium size and belonging to the round, bowl-shaped or goblet-shaped forms. Calyx round, bowl-shaped, constricted above the base so as to leave a flange below, and about as high as wide. Sutures distinct, surface smooth or granular. Column flattened, twisted, and composed of thick plates.

The basals form a cup, constricted above the base. First radials longer than wide, with a very slight increase in width upward. Articulating facets for the second radials occupy one half the width of the plates. Second radials very short, axillary, and bear upon each upper sloping side two secondary radials, the last being axillary and bearing, upon one side, a free arm, while the other arm bifurcates, on the second plate, which arrangement gives to each ray six arms. There are, therefore, thirty arms in this species. The arms are robust and in the lower part are composed of cuneiform plates, but above, they are composed of a double series of interlocking plates. They bear long, coarse pinnules. Vault unknown.

If we had only the calyx of this species we might be unable to distinguish it from some of the smooth, round, constricted forms, but the coarse thirty arms will serve, at all times, to distinguish it. Another specimen than the one illustrated shows the constricted basal plates.

Found by Earl Douglass, on Bridger Mountains, near Bozeman, Montana, and now in the collection of S. A. Miller.

PLATYCRINUS SHARONENSIS, n. sp.

Plate III, Fig. 6, basal view; Fig. 7, side view of basal plates.

We have a number of large basal discs of *Platycrinus*, which are too poor for proper specific definition, though we know they are undescribed. We usually think we know the column of a *Platycrinus*, by its twisted form and elliptical, transverse section, but we frequently find them larger than any described species. We have, in this instance only the basal plates, but they are so striking and extraordinary that we feel warranted, though with some hesitation, in giving them a name.

Species very large. Calyx round, bowl-shaped and broadly truncated below, evidently for a very large column. Columnar canal very large and round.

Basal plates almost equal in size, though one of them is quadrangular, which shows that we have a *Platycrinus* before us. The basal plates form an expanded basin with a broad, flat bottom. It is nearly three times as wide as high, and the flat bottom for the attachment of the column is nearly three fourths as wide as the top. It is constricted so as to form a basal rim which is nodose or notched. There are rounded nodes on either side of each suture, from the base to the top, and a few rounded nodes on other parts of the plates. Otherwise, the surface of the plates is finely granular. The ornamented basal rim would seem to be a support to the base of the calyx, but the upper part of the basal plates is thin for so large a species.

Found in the Burlington Group, near Sharon, in southwestern Missouri, by R. A. Blair, and now in the collection of S. A. Miller.

PLATYCRINUS BRIDGERENSIS, n. sp.

Plate III, Fig. 8, azygous view.

Species rather below medium size, and belonging to the pentagonal, bowl-shaped forms. Sutures not beveled. Surface finely granular. Plates thick. Column small and round.

Basals form a low cup two and a half times as wide as high and constricted above the base so as to form a basal rim.

Articulating facets for the second radials occupy one-third the width of the plates. Second radials very short, axillary, and bear upon each upper sloping side two secondary radials, the last being axillary, and bearing upon one side, a free arm, while the other arm bifurcates on the second plate, which gives six arms to each ray. There are, therefore, thirty arms in this species. The arms are slender and composed of alternating cuneiform plates, having very fine pinnules.

Found by Earl Douglass, on Bridger Mountain, near Bozeman, Montana, and now in the collection of S. A. Miller.

FAMILY DICHOCRINIDÆ.

DICHOCRINUS BOZEMANENSIS, n. sp.

Plate III, Fig, 4, azygous view of calyx and arms.

Species medium size. Calyx obconoidal, nearly as high as wide. Surface longitudinally lined or sculptured, but this feature is not shown in the illustration, because the upper surface of the calyx is worn and it would have to be supplied; some of the ornamentation only, in the lower part of the specimen is preserved. Sutures not impressed. Column small and round.

The two basals form a little cup about twice as wide as high. It is contracted above the bottom so as to leave an expanded basal rim. The first radials are a little less than twice as long as wide and very slowly increase in width to the superior end, which bears a concave facet about one-half the width of the plate for the attachment of the second radial or first brachial. Second radial short, rounded. Third radial about the size of the second, pentagonal, axillary and supports upon the upper sloping sides the free arms, The arms bifurcate on the third plate, giving four arms to each ray. There are, therefore, twenty arms in this species, provided only, that the ray opposite the azygous plate, which cannot be seen in our specimen, is like the others. The arms are long and composed of a single series of cuneiform plates, each one of which bears a long, coarse pinnule. The vault cannot be seen in our specimen.

Found in the Upper Burlington or Lower Keokuk, on Bridger Mountains, near Bozeman, Montana, by Earl Douglass, and now in his collection.

TALAROCRINUS PATEI, n. sp.

Plate III, Fig. 9, view opposite the azygous side of a large specimen; Fig. 10, azygous side of same; Fig. 11, azygous side of a small specimen, plates of the vault, though preserved, are not indicated; Fig. 12, opposite view of same.

We have ten specimens belonging to this species, the smallest of which is not half as large as the smaller one illustrated; the larger one illustrated is the largest in the collection.

General form of the calyx and vault, somewhat obovate. Calyx broadly truncated and somewhat in the form of the frustum of a cone.

Plates convex. Sutures depressed. Surface very finely granular. Column round, medium size.

Basals pentagonal and form a cup about one-fourth the height of the calyx, having a concave depression around the column, which is inserted in a hemispherical cavity. First radials large, convex, longer than wide, four of them are of about the same size and rest on straight faces of the basals; the other one is larger and rests in the obtuse angle formed at the union of the two basals. The second radials are very small, short, triangular, occupy about one-third the width of the first radials, axillary and support on each upper sloping side a single small secondary radial. The secondary radials are highly convex, axillary and support on each upper sloping side the free arms. There are, therefore, twenty arms in this species. The first arm plates are small, round and convex. Whether the arms bifurcate after becoming free is unknown. The convexity of the first radials leaves the small second radials resting on the inner margin, which produces an apparent constriction of the calyx at the top of the first radials.

The first azygous plate is in line with the first radials and is longer than either of them. The superior end appears to curve over upon the vault.

The vault is not large, somewhat pyramidal by reason of the interradial depressions, and covered with nodose and spinous plates.

This species is so readily distinguished from *T. trijugis* and *T. cornigerus*, its nearest allies, that no comparison is necessary.

Found by W. F. Pate, a collector and Principal of the Lebanon schools of Kentucky, in whose honor we have proposed the specific name, in the Kaskaskia Group, in Breckenridge county, Kentucky, and now in the collection of Wm. F. E. Gurley.

CLASS STELLERIDA.

ORDER ASTEROIDEA.

FAMILY PALÆASTERIDÆ.

PALÆASTER WYKOFFI, n. sp.

Plate III, Fig. 27, ventral side.

Species medium size. Rays petaliform; length about one and a half times the diameter of the body; breadth of a ray at the place of junction with the body, about two-thirds the diameter of the body; obtusely pointed.

Marginal plates wider than long and numbering about fifteen in the length of half an inch from the body. The marginal plates curve regularly around the tips of the rays. The adambulacral range curves around the ends of the rays within the marginal plates and consists of subquadrate plates, wider than long. They are a little shorter than the marginal plates, so that there are about eighteen in the length of half an inch. There are ten oral plates at the junction of the adambulacral rows which present triangular extensions toward the center of the ventral cavity. A single, irregular, axillary plate rests between the terminal marginal plates and the angle formed at the junction of the adambulacral plates. The ambulacral plates have their greatest length across the rays, thus providing a wide ambulacral furrow. Each plate is furnished with a sharp ridge in the middle, extending from the middle furrow to the adambulacral plates.

Our specimen exposes only the ventral side and no spines are preserved. It is a well-marked and beautiful species.

Found in the upper part of the Hudson River Group, near Madison, Indiana, by Chas. W. Wykoff, in whose honor we have proposed the specific name, and now in the collection of Wm. F. E. Gurley.

? ? ? ? ? ?

Plate II, Fig. 30, summit; Fig. 31, side view; Fig. 32, under side.

This is a spheroidal bulb, composed of nodose, sculptured plates. The sculpturing makes them pyramidal, and, on the under side, there is a pit at each angle, which may penetrate the bulb. The plates are larger on the upper side than they are below. The lower side may have attached to some other object at the large circular aperture. If it ever attached to a crinoid, as part of the proboscis, we have no idea how it attached or to what genus or species it belonged. When a proboscis is prolonged or balloon-shaped, the orifice is at or near the summit. This has no orifice on top. We have occasionally seen crinoidal matter that did not seem to belong to any of the established orders, and *quære*, have we such a specimen here. We are free to say, we do not know where it belongs and, therefore, do not name it; but illustrate it to call special attention to it, beside we have only the specimen illustrated.

Found by R. A. Blair in the Burlington Group, at Sedalia, Missouri, and now in the collection of S. A. Miller.

CLASS BRACHIOPODA.

ORDER LYOPOMATA.

FAMILY CRANIIDÆ.

CRANIA CHESTERENSIS, n. sp.

Plate III, Fig. 24, specimen on the fenestrated portion of a bryozoan; Fig. 25, two specimens on bryozoan; Fig. 26, specimen on a shell.

Shell rather below medium size or about as large as *Crania scabiosa*, from the Hudson River Group, and very much like it in general appearance.

It is thin, discoid and subcircular in outline. The dorsal valve appears as if collapsed, or depressed in the visceral area, so as to leave an elevated rim just within the margin. The margin outside of the middle of the elevated rim is marked with lamellose lines of growth and sometimes one or two lamellose lines of growth may be detected within this elevated border, but generally the surface is smooth. There are no radiating lines. The apex of the dorsal valve consists of a smooth, obtusely pointed, subcentral elevation that rises about one-half higher than the elevated border. The ventral valve is unknown.

This species is found attached to the hardened borders and sometimes to the fenestrated expansions of *Lyropora lyra*, Hall, of which *Lyropora ranosculum*, Ulrich, is a synonym, *Lyropora subquadrans*, Hall, and *Lyropora quincuncialis*, Hall, of which *Lyropora divergens*, Ulrich, is a synonym. It is also found attached to the valves of *Sperifera* and probably to other foreign objects. When it is attached to the fenestrated expansions of *Lyropora* the fenestrules are indicated in the dorsal valve. It is gregarious.

Found in the Kaskaskia Group at Chester, Illinois, and now in the collection of Wm. F. E. Gurley.

FAMILY PHOLADOPIDÆ.

PHOLIDOPS GREENEI, n. sp.

Plate III, Fig. 16, dorsal view; Fig. 17, interior of same; Fig. 18, profile view; Figs. 19, 20 and 21, the same enlarged twice natural size.

This is a small species, collected by G. K. Greene in the washings of the debris from the Hamilton Group, near Charlestown, Ind. In general form it resembles *Pholidops cincinnatiensis* from the Hudson River Group, but this resemblance is only in the dorsal valve, for *P. cincinnatiensis* has a flat ventral valve, and a foramen at the beak, that are not possessed by this species. This species possesses the characters of the Devonian forms described by Prof. Hall from New York, but minute comparisons are unnecessary. It is sufficient to say that it is a well-marked and distinct species.

It is in the collection of S. A. Miller.

CLASS GASTROPODA.

FAMILY CALYPTRÆIDÆ.

PLATYCERAS INDIANENSE n. sp.

Plate IV, Fig. 7, lateral view of the small specimen; Fig. 8, dorsal view; Fig. 9, aperture; Fig. 10, side view of a mature shell with part of the side and sinuated end broken away.

Species rather large. The back of the body whorl, from the apex to the aperture, is sharply angular and strongly serrated. Toward the apex the shell is laterally compressed, but it expands laterally toward the aperture. The apex is sharply pointed. The shell makes about one volution, in nearly the same plane, when the apex comes in contact with the rapidly spreading body whorl.

The aperture is compressed subelliptical, in outline, in the specimen illustrated, by fig. 9, with a moderately deep sinus at the angular back of the body whorl. And the shell substance is thin, which indicates, probably, a young shell, or, it may be, the apical end of a mature specimen.

Fig. 10 represents a mature specimen. It is much extended upon the back of the body whorl and the shell gradually becomes thicker, but the aperture below the beak remains in the same position that it is in in the specimen shown in fig. 8. The aperture increases its length, and by reason of the lateral expansion of the shell with the growth, it retains a compressed subelliptical outline, but acquires a deep sharply angular sinus at the back of the shell.

The surface is marked by concentric undulating striæ, that become more and more pronounced toward the aperture. They are not shown in the illustrations.

This species is distinguished by the compressed angular serrated back of the shell, and by the compressed, subelliptical aperture having a deep, angular sinus.

Platyceras thetis var. subspinosum, as illustrated in Pal. N. Y., Vol. V, part 2, Plate III, fig. 30, has a continuation of the shell, showing the older growth, similar to that preserved in our specimens of this species, but the growth is not wholly upon the back of the shell as it appears to be in this species. There is a great difference in the growth of the shell, below the apex, in different species, and in all species the apertures must change more or less with the growth of the shell.

Found by G. K. Greene near Charlestown, Indiana, in the Hamilton Group, and now in the collection of Wm. F. E. Gurley.

CLASS CEPHALOPODA.

SUBCLASS TETRABRANCHIATA.

ORDER NAUTILOIDEA.

FAMILY MELONOCERATIDÆ.

REMELECERAS CLARKENSE n. sp.

Plate IV, Fig. 1, lateral view; Fig. 2, dorsal view; Fig. 3, ventral view of the same fragment.

Prof. Hyatt founded the genus *Remeleceras*, dedicated to Remele, an author on Cephalopods, in 1894, in the Proceedings of the American Philosophical Society, Vol. XXXII, p. 525. The genus was founded on a fragment of a cast from an unknown locality and named *R. impressum*. If we are correct in referring our species to his genus, it will serve to fix the geological range of his species and possibly point toward the locality. Our specimen is from what is called by the local collectors, in Indiana, the Knobstone Group, which is not very definite, but means the Keokuk Group and the Waverly, where the two are not separable, and the fossils are generally casts.

Our species is larger than the type. Volutions numerous. Umbilicus wide and showing almost completely each inner turn, and probably perforated. The rapid enlargement of the part preserved indicates a complete perforation. Transverse section subelliptical. The ends in fig. 2 are altogether too round, a better idea of the subelliptical section will be formed by comparing figs. 1 and 2 or figs. 2 and 3. It is the way the ends are fractured that gives this erroneous outline in fig. 2, drawn under a camera lucida. The ventral side is depressed convex, with a subangular ventro-lateral ridge on each side. Lateral sides narrowly rounded toward the umbilicus. Dorsal side has a slightly concave depression or contact furrow, a little less than one-third the lateral diameter of the shell. The sutures have broad ventral and lateral lobes with saddles ventro-laterally and at the commencement of the umbilicus, or they might be said to be indicated by a waving line. Each one forms, however, a V-shaped angle in the dorsal sinus or contact furrow. The septa are distant on the ventral side, about one-half the dorso-ventral diameter. At the small end of our specimen they are distant a little less than half the dorso-ventral diameter and at the larger end a little more than half the dorso-ventral diameter. The outer shell is unknown.

Found by G. K. Greene, in the Knobstone Group, at Sampson Springs, in Clarke county, Indiana, and now in the collection of Wm. F. E. Gurley.

FAMILY: NAUTILIDÆ.

SOLENOCHILUS HENRYVILLENSE, n. sp.

Plate IV, Fig. 4, lateral view; Fig. 5, dorsal view and transverse section, the black spot may not be the siphuncle; Fig. 6, ventral view.

Species medium size, judging from our incomplete specimen. Shell subglobose. Whorls expand laterally much more rapidly than they do dorso-ventrally. Umbilicus small, deep, perforated. Margin of the umbilicus abruptly rounded. Our specimen preserves two volutions, but a complete shell may have three or more. The volutions are deeply embracing, showing only a small margin in the umbilicus. In the early growth of the shell, a transverse section, disregarding the dorsal sinus is subquadrangular, but later, a transverse section becomes subovate. The lateral surfaces are flattened, and converge toward the ventral side. The ventral side is, in early life, depressed convex, but later, becomes sharply rounded. Septa only moderately concave, and increase their distance apart with the growth of the shell; but not so rapidly as the shell expands. The sutures have broad ventral and lateral lobes with saddles at the ventro-lateral and dorso-lateral angles.

A little of the outer shell is preserved on our specimen and it is thin, but no surface ornamentation is preserved. The living chamber is unknown. What appears to be the siphuncle is on the ventral side of the center, and our specimen has two chambers broken so as to show smooth septa, at the ventral margin, without any evidence of a siphuncle near the ventral margin, where it usually occurs in this genus.

This species is so different from *S. collectum*, which it may be said to most resemble, that a comparison is unnecessary to distinguish it.

Found by G. K. Greene, in the Knobstone Group, near Henryville, Indiana, and now in the collection of Wm. F. E. Gurley.

TEMNOCHILUS GREENENSE, n. sp.

Plate V, Fig. 3, lateral view, the body chamber and part of the air chambers not preserved. A transverse section being trapezoidal in outline, the dotted line in the figure in the text should be contracted.

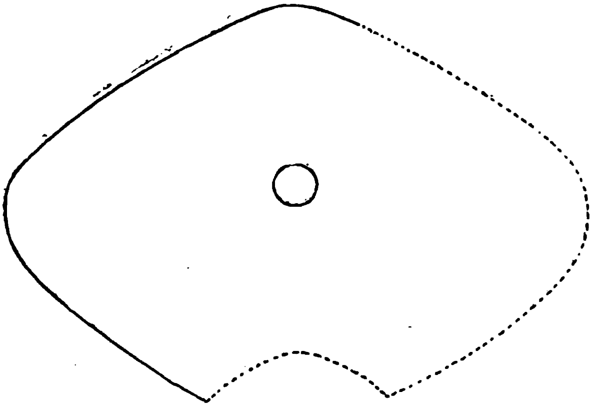


Fig. 1, transverse section, but the dotted line should be contracted to a trapezoidal outline.

Species very large, subdiscoidal, and consisting of five or more volutions, though our specimen, being imperfect, shows less than four. Umbilicus very wide, perforated and discloses about four-fifths of the dorso-ventral diameter of each inner turn. Transverse section subtrapezoidal. Our specimen is injured upon one side, and hence a correct transverse section could not be taken from it; it is clear, however, that the sides are not equal, that a section is subtrapezoidal, and that the dotted line drawn by the artist, in the figure, should be considerably contracted. The lateral diameter is near one third greater than the dorso-ventral. The ventral side is highly convex and subangular subcentrally, the lateral sides are more highly convex, subangular, and bear on the angular ridge a few very large obtuse nodes, about ten or twelve nodes on each whorl. The contact furrow is not disclosed in our specimen. The sutures are direct on the umbilical side, but form broad saddles over the angles with shallow intervening lobes. The septa are distant, on the ventral side, about one-third the dorso-ventral diameter.

The siphuncle is small, only slightly expanded within the air chambers, and situated on the ventral side of the center or between the subangular ridges on the lateral sides. Outer shell and living chamber unknown.

This species bears some resemblance to *T. coxanum*, but that is a small species, depressed convex on the ventral side, which alone is sufficient to distinguish it. Indeed there may be some doubt about this species being a true *Temnochilus*, but it seems, at least, to be nearer related to that genus than to any other.

Found in the Kaskaskia Group, on Fish Creek, in Greene county, Indiana, and now in the collection of Wm. F. E. Gurley.

SUBKINGDOM CŒLENTERATA.

. CLASS ANTHOZOA.

SUBCLASS ZOANTHARIA.

FAMILY CYATHOPHYLLIDÆ.

AMPLEXUS (?) ROCKFORDENSIS, n. sp.

Plate III, Fig. 22, side view; Fig. 23, transverse section.

Corallum medium size, simple, elongate, somewhat obconoidal, more or less twisted or curved. Epithecal crust very strongly developed, entirely covering the septa, and bearing numerous spines irregularly scattered over the whole surface.

A transverse section shows twenty-eight septa that reach about one-third of the way to the center.

Our specimen does not show the calyx, and we have no knowledge of the tabulæ except the transverse section shows a solid center in the corallum. The constrictions, if any exist, are covered by the epitheca.

We are not certain that this species belongs to Amplexus, but it is certainly a Cyathophylloid coral, and the solid center indicates an Amplexus; but if there are no constrictions it belongs elsewhere.

The remarkably thick, wrinkled, and spine-bearing epithecal crust will serve to distinguish it until more is known of the internal structure.

Found in the Kinkerhook Group, at Rockford, Indiana, and now in the collection of Wm. F. E. Gurley.

VEGETABLE KINGDOM.

CLASS FUCOIDES.

RUSOPHYCUS CHESTERENSE, n. sp.

Plate V, Fig. 1, showing three specimens on a slab.

This plant as it appears upon the slabs consists of elongated subcylindrical stems somewhat flattened upon the upper side, and having a longitudinal central depression, from which rounded ribs are directed diagonally at either side. The diameter of a stem is about half an inch, and there are about 10 rounded ribs on either side of the depression in the distance of an inch.

Found in the Kaskaskia Group, at Chester, Ill., and now in the collection of Wm. F. E. Gurley.

RUSOPHYCUS MONTANENSE, n. sp.

Plate V, Fig. 2, showing a specimen on a slab.

This plant as it appears upon the slabs consists of simple elongated subcylindrical stems, somewhat flattened upon the upper side, and having a longitudinal central depression from which rounded ribs are directed diagonally at either side. The diameter of a stem is a little more than half an inch, and there are about 3 rounded ribs on either side in the distance of half an inch. Our two specimens of this species are a little larger than any of our specimens of *R. chesterense*, and the diagonal ribs are less numerous. These characters are shown in the illustrations which fully represent both species. Of course these differences might be regarded as only of varietal value, but as the fossils are from different Groups of rocks and therefore widely separated in geological time, we prefer to distinguish them as species.

Found in the Burlington Group, in Bridger Mountains, Montana, by Earl Douglass, and now in the collection of S. A. Miller.

SPECIAL REMARKS.

After having examined numerous specimens of *Actinocrinus gibsoni* we are able to say that it is a true *Actinocrinus* with no near affinity to an *Eretmocrinus* or any species of *Batocrinus.*

In describing *Goniasteroidocrinus lyonanus* it was suggested that the functions performed by the lateral prolongations from the vault the "pseudo-ambulacral appendages" of Meek, might not be essentially distinct from those performed by the proboscis in other genera. This view we have not entertained since the study of the genus *Dolatocrinus*, as may be seen from our remarks under that genus, and also under *Batocrinus*, and under the definitions of *Gilbertsocrinus greenei* and *Goniasteroidocrinus faberi.* We now regard them as ovarian extensions. If the pores, which we have called ovarian, are really ovarian pores, there would be little doubt about these extensions from the vault belonging to the ovarian system. The great difficulty, that surrounds the assertion that they are ovarian, is the fact that some species do not have any visible pores. The proboscis in *Poteriocrinus circumtextus* is full of pores, and we have seen them in the proboscis of other species. Where the pores are, in the vault, between the arms, as in *Batocrinus*, we have not seen them penetrating the proboscis. All of which tends to show that the pores, at the margin of the calyx, at the bases of the arms and penetrating the proboscis performed similar functions, and if one is ovarian all are. If all this is a correct interpretation of the function of these orifices, it leads to the conclusion that genera, having pores at the angles of the plates of the calyx and not elsewhere, were in possession of ovarian pores that discharged through the calyx itself.

Batocrinus nodosarius occurs at Sedalia, Missouri, and also in Adams county, Illinois.

BRIEF RESUME.

In the ten Bulletins of the Illinois State Museum of Natural History, commencing with the third and ending with the present one. the authors have defined, from the palaeozoic rocks of Illinois, and adjacent states, one new Order, the Conularida, five new families, Enchostomidæ, Mitrocrinidæ, Pleurocystidæ, Porocrinidæ and Thalamocrinidæ, and ten new genera, Aesiocystites, Belemnocystites, Blairella, Emperocrinus, Enchostoma, Indianocrinus, Mitrocrinus, Sampsonocrinus, Shumardocrinus and Thalamocrinus.

We have described and illustrated more than four hundred new species of fossils, nearly all of which belong to the Echinodermata. Beside, we have redescribed and illustrated several species of other authors which had been imperfectly described or not illustrated. While doing this work, covering a period of nearly four years, we have had the opportunity of examining the principal collections to be found in these states, and we have, as we think, discovered many things relating to the structure of crinoids that were before unknown, The work must, however, speak for itself, as to our definition of the anatomical parts, and the supposed biological functions performed by them, and the supposed place in the scale of nature to which we have referred the animals.

ERRATA.

Some of the typographical errors, which may be found in the Bulletins, have been corrected with pen and ink, in part of the editions, before distribution, others have not been. The following corrections should be made:

Bulletin No. 3, p. 14, 6th line from the top, read radial for "radical." Page 17, read Eretmocrinus cassedayanus for "Eretmocrinus lyonanus." Page 18, read A. Cassaday for Sidney S. Lyon, and opposite plate III. read Eretmocrinus cassedayanus for "Eretmocrinus lyonanus." Page 47, read Taxocrinidæ for "Taxicrinidæ." Opposite plate VII, read Campophyllum kansasense for Campophyllum "kansasenis."

Bulletin No. 5, p. 9, 2d line from top for "*Steleocystites*" read *Ateleocystites* and in the third line read *wetherbyi.* Pages 8 and 18, read *kustis* for "*Kustis.*" Page 22, read *M. wetherbyi.*

Bulletin No. 6, p. 35, 20th line from top, for present read prevent. Page 39, in the last line, for "apertures" read aperture. Page 50, 9th line from the top, read truncates for "truncated." Page 52, 12th line from the top, for "cinque Foil', read cinquefoil. Opposite plate III, read tugurium for "turguium."

Bulletin No. 7, p. 13, read sampsoni for "Sampsoni" in two places. Page 47, 12th line from the bottom, read, not the light, for "that of light," and insert the word "for" between "not" and "the," in the 10th line from the bottom, and, on same page, read chouteauensis for "Chouteauensis." Page 83, read *krinon* for "*Krimon.*" Page 89, 12th line from the bottom, read or, for "as."

Bulletin No. 8, p. 6, 15th line from the bottom, and in the last line, read *sinuosus* for "*sinnosus.*" Page 8, 17th line from the top, read *lactus* for "*lactus.*" Page 38, 20th line from the top, read there for "then." Page 64, read *siluricus* instead of "*Siluricus.*" Opposite plates I and II read jessieæ for "jessiæ."

Bulletin No. 9, p. 9, read stelliformis instead of "stelliformuis," Page 15, read nitens for "niteus." Page 23, in the first line of the last paragraph, read furnishes for "furnished." Page 26, read pollubrum instead of "pallubrum." Page 36, 7th line from the bottom, read slowly for "showing." Opposite plate I, read pollubrum instead of "pallubrum," and nitens instead of "niteus." Opposite plate II, spurius instead of "spurious."

Bulletin No. 10, p. 27, read complanatus instead of "complanutus." Page 46, 2d line from the bottom, read constricted, instead of "constructed." Page 59, 1st line, in the 3d paragraph, read seven instead of "seventeen." Page 64, 7th line from the top, read *cognatus* instead of "Cognatus." Opposite plate I, read complanatus for "complanutus."

Bulletin No. 11, p. 6, Lunulicardium grande is from the Chouteau limestone, at Sedalia, Mo., instead of the Ham. Gr. at Providence. Page 6, 6th line from the bottom, read valves for "values." Page 8, last line but one in the 1st paragraph, read fine for "five." Page 15, 6th line in 2d paragraph, read lunule for "lunnule." Page 20, 9th line from the bottom, read fine for "five." Page 24, 13th line from the top, insert after the word "inches," on one side an inch. And make the rest of the sentence read "and on the other one and two-tenths inches." Page 27, last line in the 1st paragraph, read inch for "arch." Page 29, 3d line from the bottom read *Hyolithidæ* for "*Hyolithadæ*." Page 30, read specific name dunleithense for "dunleithensis." Page 31, read specific name caldwelli for "caldwellensis." Page 33, 2d line from the bottom, read recurving for "recurring." Page 41, 4th line from the top, read outer for "other," and in the 14th line insert between "authors" and "in" the words, referred to. Page 43, 5th line from the bottom, read umbilicus for "ambilicus." Page 44, 8th line from the top, read at for "as." Page 47, 3d and 4th lines in 3d paragraph, read ectorhin and endorhin for "ectorhim" and "endorhim." Page 49, 2d line in 3d paragraph, read wildly for "widely." Page 50, 1st line, read overlooked for "overlook." Opposite plate I, read Edmondia for "Edmundia." Opposite plate 3, read dunleithense for "dunleithensis." Opposite plate 4, read caldwelli, jerseyense and blairi for "caldwellensis," "jerseyensis," and "blari."

We have not undertaken to correct the typographical errors in spelling ordinary English words, or in using the singular or plural, where the errors are manifest to an intelligent reader, but have noticed the errors in spelling technical words. omissions and where the correct word might be left in doubt.

INDEX

TO BULLETINS 3 TO 12, INCLUSIVE, OF THE ILLINOIS STATE MUSEUM OF NATURAL HISTORY.

Actinocrinidæ .... X. 73
Actinocrinus albersi .... VII, 46
"   arrosus .... III, 15
"   augustatus .... III, 11
"   bischoffi .... X, 8
"   botruosus .... VI, 22
"   erraticus .... III, 14
"   foveatus .... VII, 49
"   gibsoni .... III, 10
"   jessieæ .... VIII, 32
"   monticuliferus .... V, 46
"   pettisensis .... X, 6
"   plagosus .... III, 16
"   pollubrum .... IX, 26
"   sampsoni .... X, 5
"   senectus .... XII, 36
"   sobrinus .... X, 10
"   spectabilis .... X, 9
"   subpulchellus .... X, 13
"   subscitulus .... X, 12
Æsiocrinus angulatus .... III, 59
Æsiocystites n. gen. .... V, 13
Æsiocystites priscus .... V, 14
Agaricocrinus, remarks on the genus .... XII, 9
Agaricocrinus adamsensis .... IX, 24
"   arcula .... VI, 30
"   hodgsoni .... VIII, 23
"   illinoisensis .... VIII, 25
"   iowensis .... XII, 5
"   keokukensis .... XII, 7
"   profundus .... VI, 26
"   tugurium .... VI, 28
Agassizocrinus ovalis .... IX, 36
Agelacrinus legrandensis .... V, 15
"   pulaskiensis .... V, 16
Alloprosallocrinus celsus .... V, 47
Amphoracrinus blairi .... VIII, 26
"   jessieæ .... X, 21
"   sampsoni .... IX, 27
"   sedaliensis .... VII, 54

Amplexus rockfordensis XII, 53
Archæocrinus asperatus V, 19
" knoxensis VI, 34
" parvus V, 21
" peculiaris V, 17
Barycrinus elrodi VIII, 38
" expansus V, 41
" formosus III, 33
" neglectus IX, 28
" sampsoni X, 81
" washingtonensis VI, 49
Batocrinus, abnormal specimens X, 64
Batocrinus adamsensis VIII, 14
" æquabilis III, 25
" affinis X, 55
" albersi X, 38
" altiusculus III, 20
" approximatus X, 56
" arcula VI, 16
" argutus VIII, 9
" " X, 66
" asper VIII, 13
" asperatus VIII, 12
" aspratilis III, 21
" basilicus VIII, 11
" broadheadi VII, 15
" burketi VI, 19
" cassedayanus III, 17
" casualis VI, 15
" casula VI, 8
" cistula VIII, 18
" cognatus X, 60
" commendabilis VI, 25
" complanatus X, 27
" consanguineus X, 63
" copiosus V, 51
" curiosus VI, 6
" delicatulus IX, 12
" douglassi XII, 12
" enodatus X, 46
" enodis X, 25
" faberi IX, 18
" folliculus VIII, 15
" formaceus VII, 24
" germanus VIII, 5
" glaber X, 32
" heteroclitus VII, 31
" hodgsoni VIII, 8
" honorabilis VI, 10
" ignotus VII, 28
" imparilis VII, 20
" inconsuetus VII, 25
" incultus VII, 21
" inopinatus VII, 36
" insolens X, 35
" insperatus VII, 22

Batocrinus, insuetus .... VII, 14
" jessieæ .... VIII, 20
" labellum .... VI, 21
" laciniosus .... VI, 14
" laetus .... III, 24
" laterna .... VI, 12
" levigatus .... X, 29
" levis .... X, 23
" lyonanus .... III, 18
" modestus .... VII, 30
" modulus .... VIII, 16
" nanus .... VIII, 17
" nitens .... IX, 15
" nitidulus .... VII, 17
" nodosarius .... X, 22
" nodosus .... IX, 5
" nodulosus .... IX, 6
" parilis .... IX, 17
" peculiaris .... VII, 18
" pettisensis .... IX, 19
" pileus .... VI, 18
" planus .... VII, 37
" politus .... X, 31
" polydactylus .... VII, 5
" procerus .... VII, 33
" prodigialis .... VII, 39
" proximus .... VIII, 7
" regalis .... IX, 14
" reliquus .... XII, 22
" remotus .... X, 43
" repertus .... X, 70
" repositus .... X, 45
" reservatus .... XII, 25
" rotuliformis .... XII, 26
" rudis .... X, 52
" rusticellus .... XII, 23
" rusticus .... XII, 28
" saccellus .... X, 40
" sacculus .... V, 52
" sagetownensis .... X, 54
" salemensis .... IX, 8
" sampsoni .... VII, 7
" scitulus .... XII, 19
" scyphus .... III, 23
" sedaliensis .... X, 71
" selectus .... X, 37
" senex .... XII, 21
" serratus .... VII, 27
" sharonensis .... XII, 18
" signatus .... IX, 10
" solitarius .... VIII, 22
" speciosus .... X, 47
" spinosus .... VI, 5
" spurius .... IX, 20
" stelliformis .... IX, 9
" strenuus .... IX, 11

Batocrinus subæquatus .... X, 72
" **sublævis** .... X, 41
" **subovatus** .... X, 50
" **subrotundus** .... X, 48
" **subscitulus** .... X, 51
" **variabilis** .... X, 58
" **venustulus** .... VII, 12
" **veterator** .... VII, 8
" **vetustus** .... VII, 10
" **vicinus** .... VII, 34
" **wetherbyi** .... VI, 11
Belemnocystites, n. gen. .... V, 8
" wetherbyi .... V, 9
Bellerophon blairi .... XI, 21
" sedaliensis .... XI, 21
Blairella, n. gen .... XI, 6
" sedaliensis .... XI, 7
Blairocrinus spinosulus .... III, 28
Brief Resume .... XII, 56
Calceocrinus kentuckiensis .... V, 29
Campophyllum kansasense .... III, 67
Carabocrinus ovalis .... V, 25
Caryocrinus bulbulus .... V, 11
" ellipticus .... V, 10
" hammelli .... IX, 65
" kentuckiensis .... VI, 59
" milliganæ .... IX, 63
Ceraurus milleranus .... III, 80
Chænomya longa .... XI, 8
Codaster blairi .... VII, 86
" jessieæ .... X, 89
Conularida, n. ord .... XI, 22
Conularidæ .... XI, 23
Conularia blairi .... III, 73
" gattingeri .... XI, 23
" gratiosa .... III, 74
" greenei .... XI, 27
" roeperi .... XI, 26
" sedaliensis .... XI, 28
" spergenensis .... III, 74
Crania chesterensis .... XII, 47
Crinoid bases .... IV, 31
Cyathocrinus andersoni .... III, 30
" blairi .... VII, 67
" " .... VIII, 50
" " .... IX, 39
" brittsi .... VII, 70
" chouteauensis .... VII, 68
" " .... IX, 38
" faberi .... X, 85
" labyrinthicus .... IX, 34
" macadamsi .... VII, 69
" signatus .... III, 32
" tumidulus .... III, 31
" waldronensis .... VIII, 49
Cyclocystoides illinoisensis .... VI, 61
Cyclonema pulchellum .... XI, 19

Cylicocrinus (?) indianensis.......VI, 31
Cypricardella eximia.......XI, 15
Cyrtoceras dunleithense.......XI, 30
" **kansasense**.......VII, 88
Dichocrinus bozemanensis.......XII, 44
Discina illinoisensis.......III, 70
" **munda**.......III. 71
Dolatocrinus amplus.......V, 45
" aplatus.......VIII, 48
" " ....IX, 49
" approximatus.......IV, 25
" argutus.......VIII, 41
" arrosus.......IX, 52
" asper.......IX, 47
" aspratilis.......IX, 49
" aureatus.......IV, 24
" basilicus.......IX, 43
" bellarugosus.......VIII, 43
" bellulus.......VI, 57
" bulbaceus.......IV, 22
" caelatus.......VIII, 46
" charlestownensis.......VIII, 44
" cistula.......IX, 46
" corporosus.......VI, 50
" dispar.......IX, 40
" dissimilaris.......IX, 54
" exornatus.......VI, 54
" grandis.......IV, 14
" greenei.......IV, 28
" hammelli.......VI, 52
" indianensis.......VIII, 40
" lacus.......IV, 9
" laguneulus.......IX, 51
" lineolatus.......IV, 27
" lyoni.......IX, 44
" magnificus.......IV. 5
" marshi.......IV, 11
" neglectus.......XII, 37
" nodosus.......VII, 56
" ornatus.......IV, 18
" ornatus var. asperatus.......IV. 16
" peculiaris.......IX, 55
" preciosus.......IX, 41
" pulchellus.......VI, 55
" sacculus.......VII, 58
" salebrosus.......VII, 59
" spinosus.......IV, 8
" stellifer.......IV, 20
" vasculum.......VI, 53
" venustus.......IV, 23
Dorycrinus alabamensis.......X, 15
" **faberi**.......X, 19
" **greenei**.......V, 48
" **sampsoni**.......X, 17
" **suboviformis**.......XII, 30

Eatonia coulteri III, 72
Edmondia albersi XI. 8
Elymella missouriensis XI, 15
Emperocrinus, n. gen. VI, 42
'' indianensis VI, 43
Enchostomidæ, n. fam. XI, 30
Enchostoma, n. gen. XI, 29
'' lanceolatus XI, 29
Eretmocrinus cassedayanus III, 17
'' commendabilis VI, 25
Errata XII. 57
Eucalyptocrinus milliganæ X, 88
'' wortheni III, 53
Eupachycrinus parvus III. 60
Eurypterus kokomoensis X, 90
Forbesocrinus greenei IX, 57
'' jerseyensis VIII. 58
'' macadamsi IX. 58
'' multibrachiatus VIII. 55
'' pyriformis III, 47
'' washingtonensis VIII, 54
Gilbertsocrinus indianensis VI, 38
'' greenei VI, 35
Glyptaster milliganæ X. 87
Glyptocrinus mercerensis V, 28
Goniasteroidocrinus faberi X, 84
'' lyonanus III, 55
Goniatitidæ XI, 33
Goniatites blairi XI, 35
'' elkhornensis XI, 37
'' fultonensis XI. 39
'' greencastlensis XI, 44
'' illinoisensis XI. 42
'' jessieæ XI, 46
'' kansasensis XI, 43
'' kentuckiensis XI, 40
'' lunatus XI, 41
'' mithrax XI, 33
'' montgomeryensis XI. 38
'' parrishi XI. 36
'' subcavus XI, 45
Granatocrinus sphaeroidalis III, 65
'' winslowi III, 66
Hadrophyllum tennesseense VII, 87
Holocystites asper VII, 84
'' gyrinus V, 5
'' sphaeroidalis VII, 85
'' splendens V, 7
Holopea grandis XI, 19
Hydreionocrinus crassidiscus III, 43
'' granuliferus III, 44
'' noduliferus III, 41
'' sanctiludovici III, 40
'' subsinuatus III, 40
Ichthyocrinus clarkensis V 43
'' spinosulus V, 44
Illaenus danielsi III, 76

Indianocrinus, n. gen. .... VII, 83
" punctatus .... VII, 83
Interesting letter .... IV, 37
Lecanocrinus greenei .... VIII, 52
" oswegoensis .... IV, 33
Lichas byrnesanus .... III, 78
" hanoverensis .... III, 78
Lingula indianensis .... III, 69
Liopteria speciosa .... XI, 13
" subovata .... XI, 13
Lunulicardium grande .... XI, 5
" retrorsum .... XI, 6
Macrodon blairi .... XI, 11
" facetus .... XI, 10
" pettisensis .... XI, 10
Macrostylocrinus indianensis .... VI, 33
Megistocrinus expansus .... IV, 35
" hemisphericus .... VII, 44
" indianensis .... VIII, 27
" ornatus .... VII, 42
Melocrinus sampsoni .... VII, 55
Melonites indianensis .... III, 5
Michelinia branneri .... III, 68
Mitrocrinidæ, n. fam. .... V, 22
Mitrocrinus, n. gen. .... V, 22
Mitrocrinus wetherbyi .... V, 22
Murchisonia indianensis .... XI, 18
Mytilarca jessieæ .... XI, 14
Nucleocrinus greenei .... III, 62
" venustus .... III, 63
Oligoporus bellulus .... III, 7
" blairi .... III, 6
" sulcatus .... III, 8
Onychocrinus parvus .... III, 52
" pulaskiensis .... VI, 40
Orthoceras caldwelli .... XI, 31
Palæaster wykoffi .... XII, 46
Palæosolen occidentalis .... XI, 16
Pholidops greenei .... XII, 48
Physetocrinus sampsoni .... X, 14
Pisocrinus baccula .... VII, 79
" milligani .... VII, 80
Platyceras indianense .... XII, 48
Platycrinus bozemanensis .... XII, 42
" bridgerensis .... XII, 43
" casula .... VII, 76
" clinatus .... VII, 74
" concinnulus .... IX, 63
" cortina .... V, 40
" douglassi .... X, 86
" formosus, ... VII, 72
" " var approximatus .... IX, 60
" germanus .... VII, 78
" hodgsoni .... VIII, 63
" illinoisensis .... VIII, 62
" missouriensis .... VII, 73

Platycrinus modestus .... VII, 77
'' pettisensis .... VII, 73
'' semifusus .... VII, 77
'' sharonensis .... XII, 42
'' subscitulus .... IX, 62
'' sulciferus .... VII, 75
'' tugurium .... VII, 70
'' vascellum .... VI, 32
Pleurocystidæ n. fam .... VI, 60
Pleurocystites mercerensis .... VI, 60
Porocrinidæ, n. fam .... V, 24
Porocrinus kentuckiensis .... V, 24
Posidonomya lasallensis .... XI, 12
Poterioceras jerseyense .... XI, 32
Poteriocrinus albersi .... IX, 29
'' altonensis .... VII, 62
'' arrectarius .... IX, 33
'' blairi .... VII, 61
'' bozemanensis .... X, 82
'' broadheadi .... VII, 63
'' circumtextus .... V, 31
'' douglassi .... X, 83
'' hammondi .... V, 35
'' labyrinthicus .... IX, 34
'' lautus .... IX, 30
'' maccabei .... V, 34
'' '' var. decrepitus .... V, 36
'' neglectus .... IX, 31
'' pulaskiensis .... VIII, 39
'' sampsoni .... VII, 65
'' scopæ .... V, 33
'' vagulus .... VI, 46
Pterotocrinus wetherbyi .... VI, 44
Receptaculites dixonensis .... XI, 47
Retiocrinus alveolatus .... V, 26
Rhodocrinus blairi .... IX, 37
'' bozemanensis .... XII, 40
'' bridgerensis .... XII, 41
'' douglassi .... XII, 39
Rusophycus chesterense .... XII, 54
'' montanense .... XII, 54
Saccocrinus umbrosus .... VI, 24
Sampsonocrinus n. gen. .... VII, 51
'' hemisphericus .... VII, 51
Scaphiocrinus arrosus .... III, 39
'' martinensis .... III, 38
'' notatus .... IX, 34
Schizodus sedaliensis .... IX, 17
Shumardocrinus n. gen .... VII, 40
'' concinnus .... VII, 41
Solenochilus henryvillense .... XII, 51
Special remarks .... XII, 55
Sphenotus sinuatus .... XI, 9
Spirorbis blairi .... VII, 89
Steganocrinus albersi .... XII, 33
'' blairi .... XII, 35
'' griffithi .... XII, 34

Steganocrinus sharonensis .... XII, 32
" spergenensis .... VIII, 29
Stereocrinus indianensis .... XII, 38
Straparollus missouriensis .... XI, 20
Stribalocystites sphaeroidalis .... VI, 58
Strotocrinus blairi .... VII, 48
" ornatus .... VIII, 30
" venustus .... III, 26
Synbathocrinus angularis .... V, 42
" illinoisensis .... VIII, 53
Talarocrinus trijugis .... III, 45
" patei .... XII, 44
Taxocrinus crawfordsvillensis .... III, 49
" splendens .... VIII, 61
" wetherbyi .... VI, 41
" ungula .... VIII, 59
Temnochilus greenense .... XII, 52
Thalamocrinidæ, n. fam. .... VII, 81
Thalamocrinus, n. gen. .... VII, 81
" cylindricus .... VII, 82
" ovatus .... VII, 82
Thysanocrinus milliganæ .... VIII, 51
Ulocrinus blairi .... III, 57
" occidentalis .... III, 58
Zeacrinus bellulus .... III, 34
" blairi .... VII, 66
" cylindricus .... V, 38
" doverensis .... VIII, 35
" durabilis .... VI, 48
" grandiculus .... V, 32
" kentuckiensis .... VIII, 37
" nitidus .... III, 36
" obesus .... III, 35
" peculiaris .... VIII, 34
" pulaskiensis .... VI, 47
" salemensis .... V, 37
? ? ? ? ? .... XII, 46

PLATE I.

PAGE.

AGARICOCRINUS IOWENSIS, n. sp 5

Fig. 1. Basal view.
Fig. 2. Summit.
Fig. 3. Azygous view.

AGARICOCRINUS KEOKUKENSIS, n. sp 7

Fig. 4. Basal view.
Fig. 5. Summit.
Fig. 6. Azygous view.

BATOCRINUS SHARONENSIS, n. sp 18

Fig. 7. Azygous view.
Fig. 8. Opposite side of same.
Fig. 9. Lateral view.

BATOCRINUS SCITULUS, n. sp 19

Fig. 10. Azygous view.
Fig. 11. Opposite side of same.

BATOCRINUS SENEX, n. sp 21

Fig. 12. Azygous view.
Fig. 13. Opposite side of same.
Fig. 14. Summit of another specimen.

BATOCRINUS RELIQUUS, n. sp 22

Fig. 15. Basal view.
Fig. 16. Azygous view.
Fig. 17. Summit.

BATOCRINUS RUSTICELLUS, n. sp 23

Fig. 18. Basal view.
Fig. 19. Same, magnified two diameters.
Fig. 20. Azygous view.
Fig. 21. Summit.

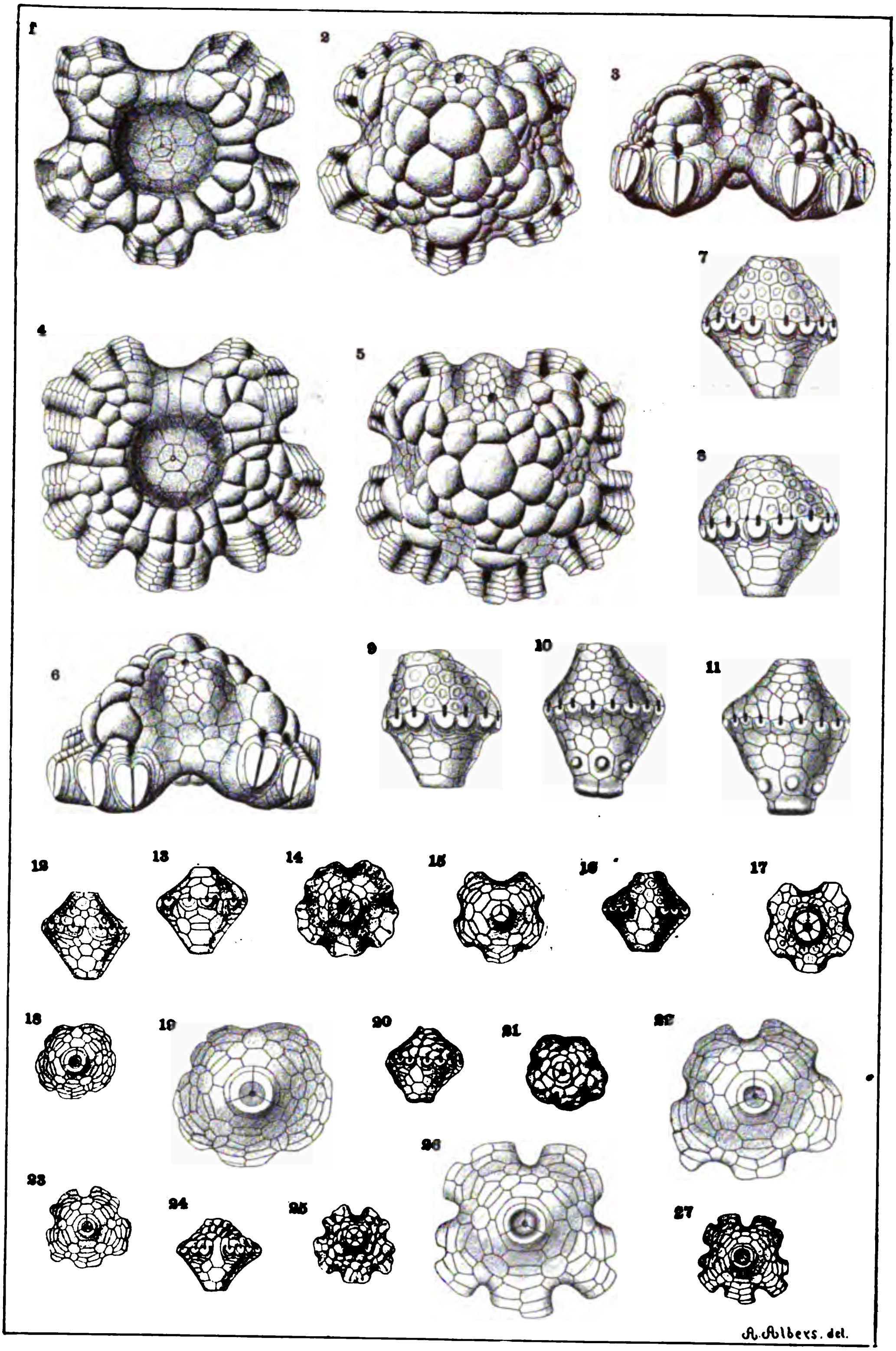
BATOCRINUS RESERVATUS, n. sp 25

Fig. 22. Basal view, magnified two diameters.
Fig. 23. Same, natural size.
Fig. 24. Azygous view.
Fig. 25. Summit.

BATOCRINUS ROTULIFORMIS, n. sp 26

Fig. 26. Basal veiw, magnified two diameters,
Fig. 27. Same, natural size.

PLATE I.



A. Albers. del.

PLATE II.

PAGE.

BATOCRINUS ROTULIFORMIS, n. sp. 26

Fig. 1. Azygous view.
Fig. 2. Summit.

BATOCRINUS (?) RUSTICUS, n. sp. 28

Fig. 3. Basal view, magnified two diameters.
Fig. 4. Same, natural size.
Fig. 5. Azygous view.
Fig. 6. Summit.

DORYCRINUS SUBOVIFORMIS, n. sp. 30

Fig. 7. Azygous view.
Fig. 8. Opposite side of same.
Fig. 9. Summit.

STEGANOCRINUS SHABONENSIS, n. sp 32

Fig. 10. Azygous view.
Fig. 11. Opposite side of same.
Fig. 12. Summit.

STEGANOCRINUS ALBERSI, n. sp. 33

Fig. 13. Azygous view.
Fig. 14. Opposite side of same.
Fig. 15. Summit.
Fig. 16. Basal view.

STEGANOCRINUS GRIFFITHI, n. sp 34

Fig. 17. Azygous view.
Fig. 18. Opposite side of same.
Fig. 19. Basal view.
Fig. 20. Sumit.

STEGANOCRINUS BLAIRI, n. sp. 35

Fig. 21. View opposite azygous side.
Fig. 22. Basal view.

ACTINOCRINUS SENECTUS, n. sp. 36

Fig. 23. Azygous view.
Fig. 24. Opposite side of same.
Fig. 25. Summit.

BATOCRINUS DOUGLASSI, n. sp. 29

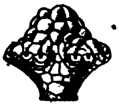
Fig. 26. View opposite azygous side.

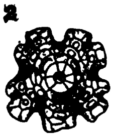
DOLATOCRINUS NEGLECTUS, n. sp. 37

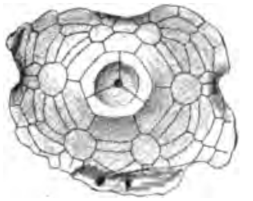
Fig. 27. Basal view.
Fig. 28. Summit.
Fig. 29. Lateral view.

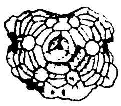
? ?.... 46

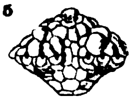
Fig. 30. Summit (?).
Fig. 31. Lateral (?).
Fig. 32. Under side (?).

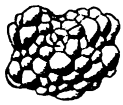
1


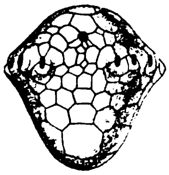
2


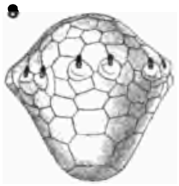
3


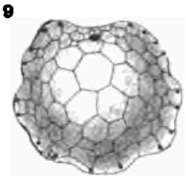
4


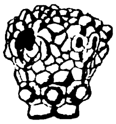
5


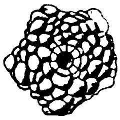
6


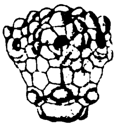
7


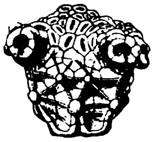
8


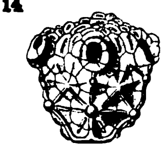
9


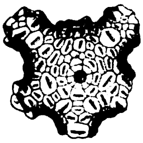
10


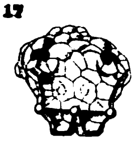
12


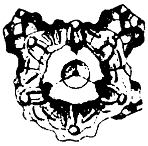
11


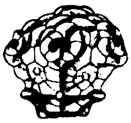
13


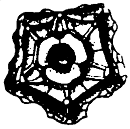
14


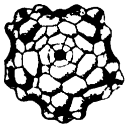
15


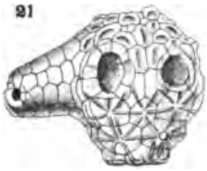
17


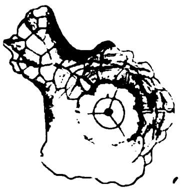
16


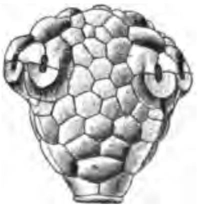
18


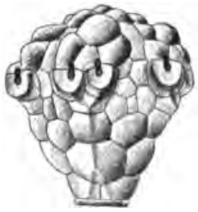
19


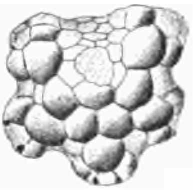
20


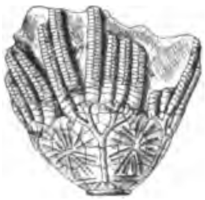
21


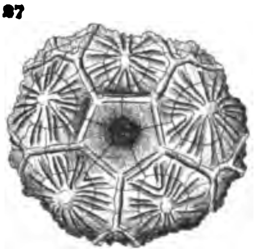
22


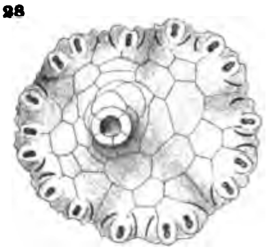
23


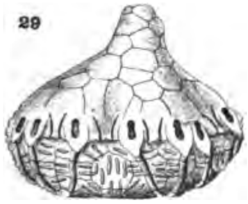
24


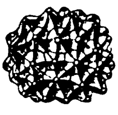
25


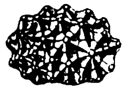
26


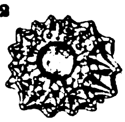
27


28


29


30


31


32


A. Albers del

PLATE III.

Page.

Rhodocrinus douglassi, n. sp. 39

Fig. 1. Azygous area on the left.

Rhodocrinus bozemanensis, n. sp 40

Fig. 2. Lateral view.

Rhodocrinus bridgerensis, n. sp. 41

Fig. 3. Lateral view.

Dichocrinus bozemanensis, n. sp 44

Fig. 4. Azygous view.

Platycrinus bozemanensis, n. sp 42

Fig. 5. Lateral view.

Platycrinus sharonensis, n. sp 42

Fig. 6. Basal view.
Fig. 7. Lateral view of basal plates.

Platycrinus bridgerensis, n. sp 43

Fig. 8. Azygous view.

Talarocrinus patei, n. sp 44

Fig. 9. View opposite azygous area.
Fig. 10. Azygous view of same.
Fig. 11. Azygous view of a smaller specimen.
Fig. 12. Opposite side of same.

Stereocrinus indianensis, n. sp 38

Fig. 13. Basal view of calyx, showing all the plates.
Fig. 14. Lateral view.
Fig. 15. Basal view of another specimen.

Pholidops greenei, n. sp 48

Fig. 16. Dorsal view.
Fig. 17. Ventral view.
Fig. 18. Profile view.
Fig. 19, 20, 21. Same magnified two diameters.

Amplexus rockfordense, n. sp 53

Fig. 22. Lateral view.
Fig. 23. End view.

Crania chesterensis, n. sp 47

Figs. 24, 25. View of specimens attached to bryozoans.
Fig. 26. View of a specimen attached to a shell.

Palaeaster wykoffi, n. sp 46

Fig. 27. View of ventral side:

PLATE III.

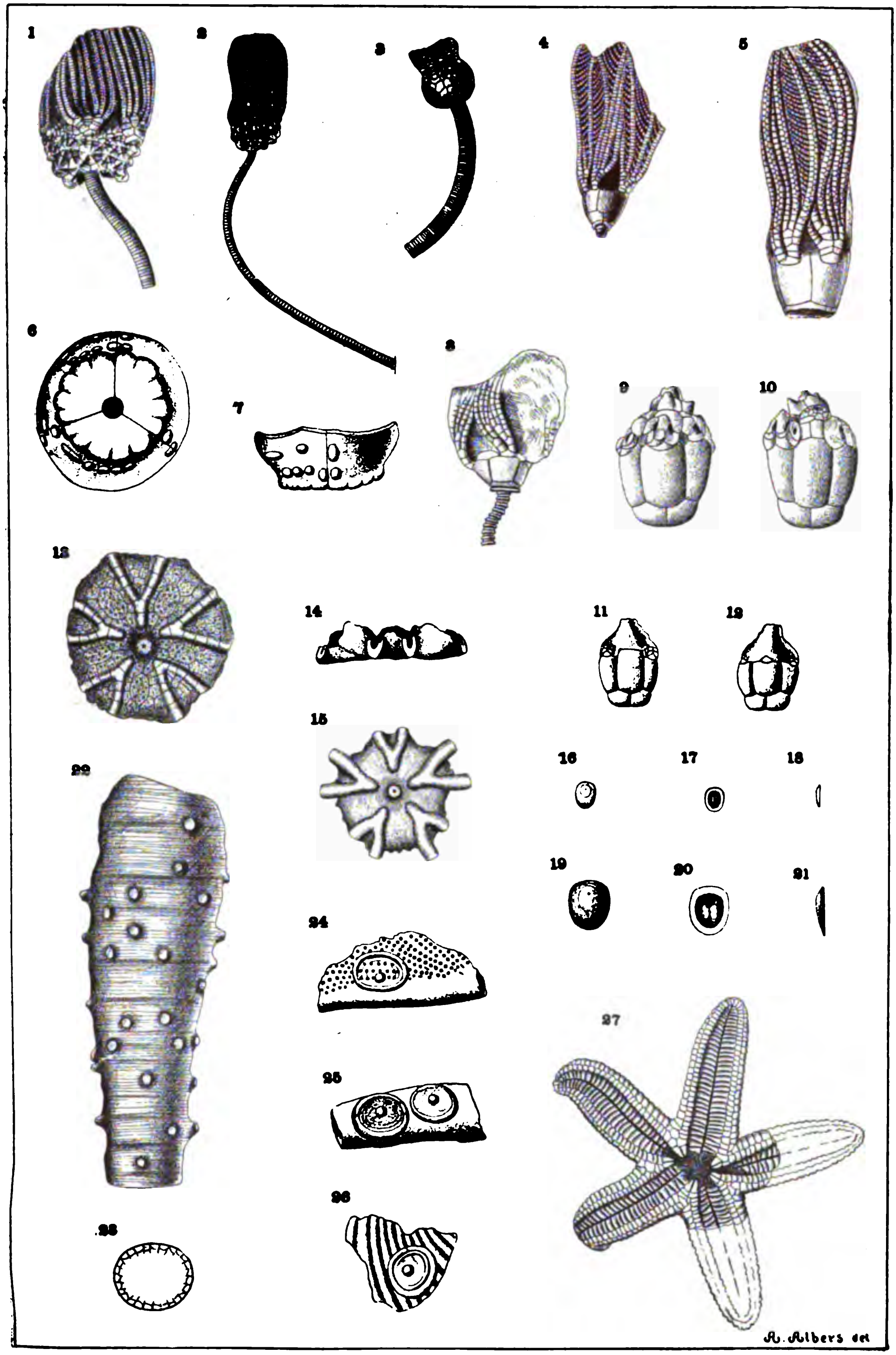

1
2
3
4
5
6
7
8
9
10
13
14
11
12
15
16
17
18
22
19
20
21
24
27
25
26
23
A. Albers del.

PLATE IV.

PAGE.

Remeloceras clarkense, n. sp. 49

Fig. 1. Lateral view.
Fig. 2. Dorsal view.
Fig. 3. Ventral view.

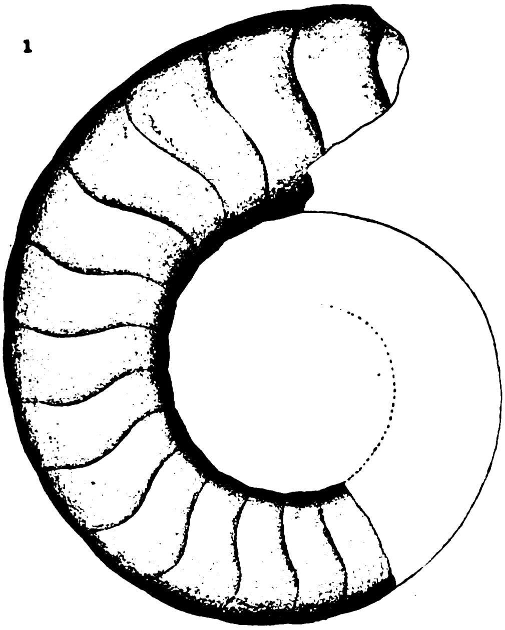
Solenochilus henryvillense, n. sp. 51

Fig. 4. Lateral view.
Fig. 5. Dorsal view.
Fig. 6. Ventral view.

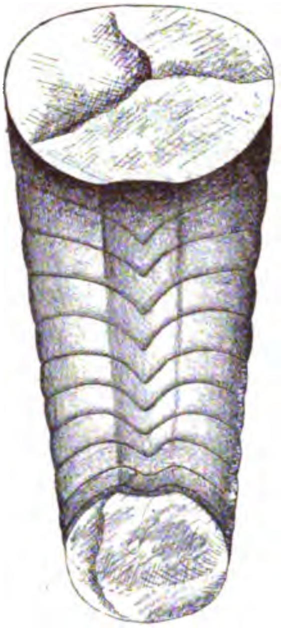
Platyceras indianense, n. sp. 48

Fig. 7. Lateral view of a small specimen.
Fig. 8. Dorsal view of same.
Fig. 9. Aperture of same.
Fig. 10. Lateral view of a larger specimen.

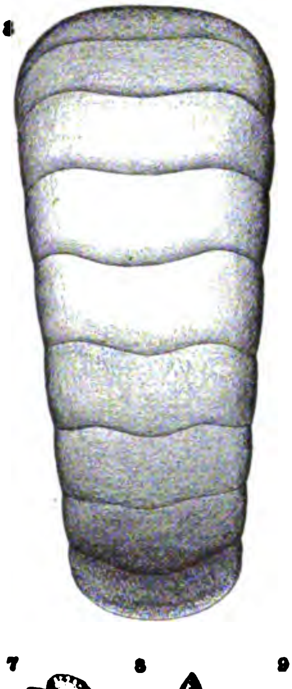
1



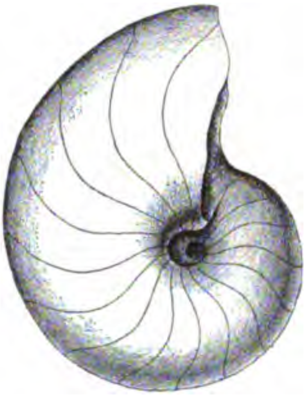
2



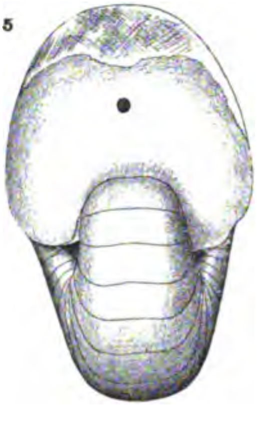
3



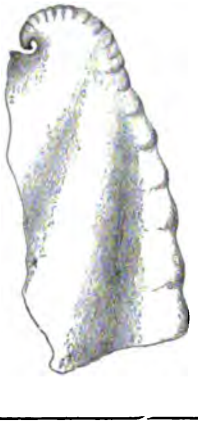
4



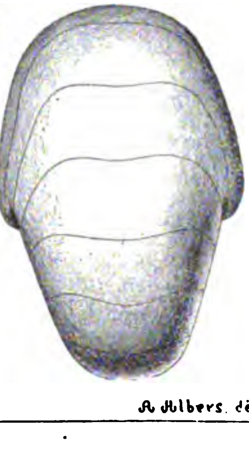
5



10

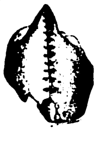


6

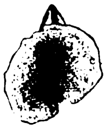


7

8



9



A. Albers. del.

PLATE V.

PAGE.

RUSOPHYCUS CHESTERENSIS, n. sp. 54

Fig. 1. Three specimens on a slab.

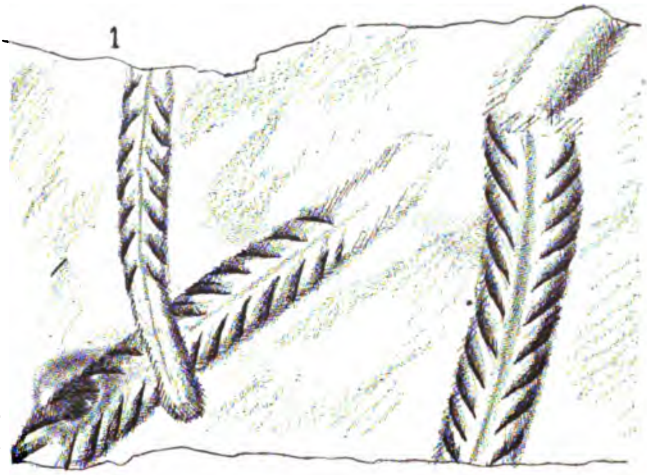
RUSOPHYCUS MONTANENSIS, n. sp. 54

Fig. 2. A specimen on a slab.

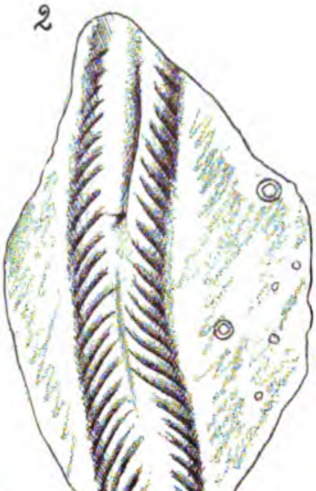
TEMNOCHILUS GREENENSE, n. sp. 52

Fig. 3. Lateral view.

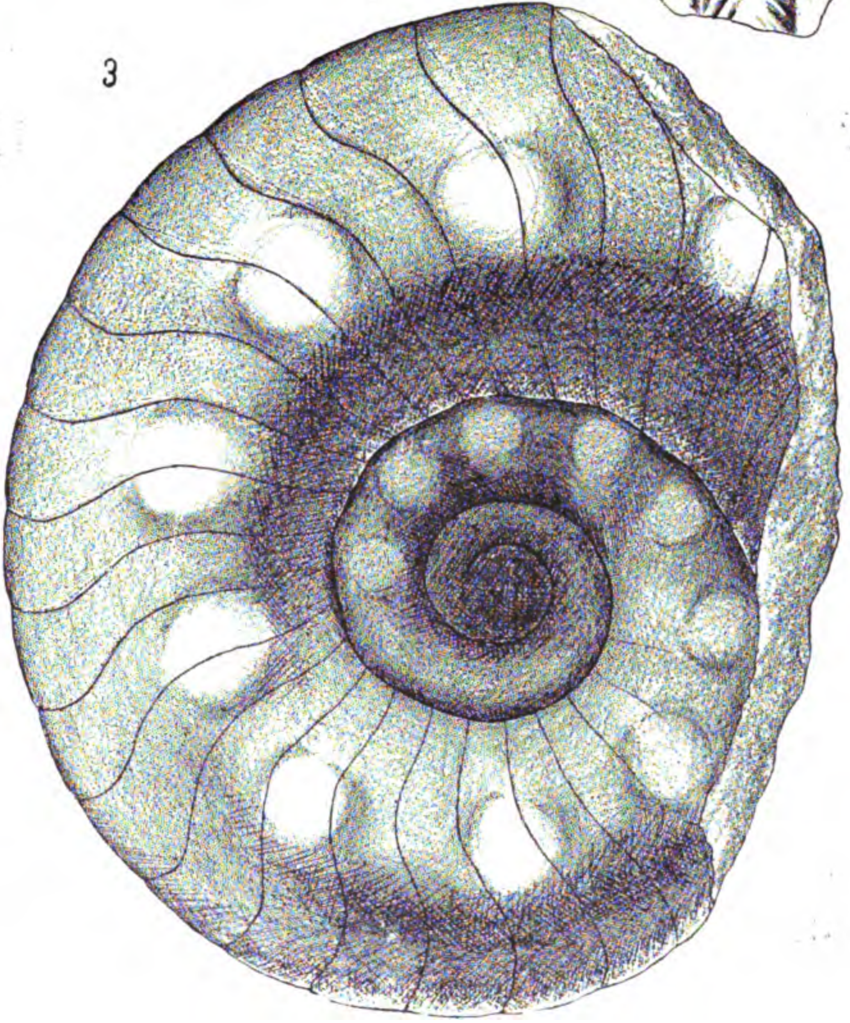
1



2



3



ALDERMAN LIBRARY

The return of this book is due on the date indicated below

DUE	DUE
[illegible]	

Usually books are lent out for two weeks, but there are exceptions and the borrower should note carefully the date stamped above. Fines are charged for over-due books at the rate of five cents a day; for reserved books there are special rates and regulations. Books must be presented at the desk if renewal is desired.

amphlet
Binder
Gaylord Bros., Inc.
Makers
Syracuse, N. Y.
PAT. JAN 21, 1908